

SAN FRANCISCO BAY NATIONAL WILDLIFE REFUGE

Fremont, California

ANNUAL NARRATIVE REPORT

Calendar Year 1990

U.S. Department of the Interior
Fish and Wildlife Service
NATIONAL WILDLIFE REFUGE SYSTEM

REVIEWS AND APPROVALS

SAN FRANCISCO BAY NATIONAL WILDLIFE REFUGE

Fremont, California

ANNUAL NARRATIVE REPORT

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Ann Klein - Acting
Refuge Manager

10/19/93
Date

Retired
Refuge Supervisor Review

10/19/93
Date

Regional Office Approval

Date

INTRODUCTION

San Francisco Bay has long been regarded as a gateway to America. So it is fitting that the San Francisco Bay National Wildlife Refuge (NWR) plays that same role as a "gateway" to the U.S. Fish and Wildlife Service programs and the 430+ units of the National Wildlife Refuge System.

In 1972, Public Law 92-330 provided for the establishment of San Francisco Bay National Wildlife Refuge for the preservation and protection of critical habitat and associated wildlife, migratory waterfowl and to provide an opportunity for wildlife-oriented recreation and nature study. In 1988, Public Law 100-556 was passed which increased our acquisition authority an additional 20,000 acres. Congress also provided \$3.75 million dollars for acquisition in Fiscal year 1990. San Francisco Bay National Wildlife Refuge encompasses approximately 19,000 acres in San Mateo, Alameda and Santa Clara counties, California at the southern end of San Francisco Bay. San Francisco Bay is one of the largest estuaries in the nation, approximately 55 miles long and 3 to 12 miles wide.

Under an agreement between the Leslie Salt Company and the Service when the Refuge was established, approximately 12,500 acres remain as active salt evaporation ponds. The remaining habitat consists of salt marshes, upland, tidal mudflats and open water.

This variety of habitat supports a large number of wildlife, including 5 endangered species. The Refuge provides major habitat for the endangered California clapper rail and salt marsh harvest mouse. San Francisco Bay is a key wintering area for diving ducks along the Pacific Flyway; the south bay is used primarily by scaup, surf scoters and ruddy ducks. The south bay wetlands support hundreds of thousands of shorebirds along with the largest wading bird rookery located in the bay.

Marine mammals also utilize the open water and sloughs. A major harbor seal haul out site is located in Mowry Slough.

San Francisco Bay National Wildlife Refuge is surrounded by an urban population of 5 million people. In spite of the potential impacts of encroaching development, plans are to complete acquisition of the approved 43,000 acres.

The Refuge is also a place to learn about the Bay environment through exhibits and naturalist programs; to observe and photograph wildlife; to hike, hunt and fish; and to enjoy some precious natural habitats in the heart of a great metropolitan area.

Included in the San Francisco Bay NWR Complex are eight coastal refuges, stretching from Monterey Bay to the Oregon border. This complex is a unique combination of habitats and wildlife species. The San Francisco Bay NWR in the south Bay has tidal marshes and salt ponds. At the north end of the Bay is the San Pablo Bay NWR with estuarine and upland habitat. The Farallon Island NWR, which lies thirty miles off the coast from the Golden Gate Bridge, is comprised of high rocky islands frequented by a host of seabirds, seals, and sea lions. A quiet upland habitat for the endangered Santa Cruz long-toed salamander can be found at the Ellicott Slough NWR just south of Santa Cruz. The Salinas River Wildlife Management Area just north of Monterey encompasses an area of pristine beach, dunes, and lagoon habitat. Found in the small pockets of native habitat at Antioch Dunes NWR are the Antioch Dunes evening primrose, Contra Costa wallflower and the Lange's Metalmark butterfly. North of the Bay area are the estuarine and tidal flats of Humboldt Bay NWR. Finally, the off-shore island, Castle Rock NWR offers a home for the endangered Aleutian Canada Goose, seabirds, seals, and sea lions.

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K. FEEDBACK

A. HIGHLIGHTS

--The Final Environmental Assessment allowing expansion of the Refuge by up to 20,000 acres was completed (Section D.4).

--The California clapper rail population continued to decline as growing evidence of the direct impacts of the non-native red fox was collected (Sections D.5.h, G.2.d, and G.15).

--A draft Predator Management Plan and Environmental Assessment was issued, which would allow selective predator removal to protect California clapper rails and other sensitive wildlife (Section G.15).

--The field work was completed on an extensive 3-year collaborative study with the Research Division, titled, "Distribution and abundance of waterfowl on San Francisco Bay" (Sections D.5.c and G.3).

--A total of approximately 1000 hours of duty and volunteer time were totaled during staff involvement with Boy Scouts and Girl Scout programs. (Section E.2.o.)

--Volunteers donated approximately 16,500 hours of time to the Service. (Section E.4).

--The Refuge environmental education program served 11,284 students and 2623 teacher/parent leaders during the year. (Section H.2.a.b.).

--Outdoor amphitheater constructed near the Pumphouse environmental education station. (Section H.2.b.)

--Refuge officers contacted approximately 15,000 individuals and issued 300 citations. (Section H.17).

--The entire roof of the environmental education center was replaced. (Section I.2).

B. CLIMATIC CONDITIONS

In a normal year, the Bay area has a modified Mediterranean climate with warm to hot, dry summers and moist, mild winters. Ninety percent of our rainfall occurs in the late fall and winter months with January being the wettest. Normal annual rainfall amounts vary according to local topography. In the South Bay 16-20 inches is normal while some areas in the North Bay receive more than 45 inches. Drought conditions continued for the fifth consecutive year.

C. LAND ACQUISITION

1. Fee Title

On October 28, 1988, Congress passed Public Law 100-556, which increased the Services' acquisition authority from 23,000 acres to 43,000 acres for San Francisco Bay NWR. No lands were added to the San Francisco Bay National Wildlife Refuge during 1990.

D. PLANNING

4. Compliance with Environmental Mandates

On October 28, 1988, Congress passed Public Law 100-556, which increased the Services' acquisition authority from 23,000 acres to 43,000 acres for San Francisco Bay NWR. Thus, a 47 page Final Environmental Assessment entitled, "Potential Additions to the San Francisco Bay National Wildlife Refuge" was issued in March, 1990. This EA evaluated the effects associated with the land acquisition needed to protect, and where necessary, restore, enhance, and manage wetlands, uplands and deep water habitats for many species of fish, wildlife, and plants. A Finding of No Significant Impact was signed on March 5, 1990.

5. Research and Investigations

a. Distribution and ecology of *Spartina foliosa* and *Spartina alterniflora* in south San Francisco Bay:

John Callaway, Master's Degree Candidate, San Francisco State University.

This study, initiated in 1988, focuses on the distribution and interaction between *S. foliosa* a native cordgrass, and *S. alterniflora* an introduced cordgrass. Major objectives for the study were as follows:

1. Document the current distribution
2. Determine germination and growth rates
3. Response to experimental manipulation and removal

A Master's thesis was completed in 1990.

He reported that (*S. alterniflora*) was introduced 10-15 years ago and had become well established in three sites in south San Francisco Bay and was spreading in a fourth site. No differences were found in sedimentation rates in native versus non-native cordgrass zones. Callaway recommended eradication programs be undertaken before this invasive species became common in many South Bay marshes.

b. Shorebird census of northern and central California coastal wetlands:

Lynne Stenzel, Janet Kjelson, Gary Page, and David Shuford, Point Reyes Bird Observatory (PRBO).

In 1988, PRBO began this project to determine the status and future prospects for shorebirds in coastal wetlands in the Pacific Flyway. They conduct two shorebird surveys along the Pacific Coast during peak migration periods in the spring and fall. Surveys are conducted using over 100 volunteers in San Francisco Bay. Numbers peaked in April 1989 when 931,561 shorebirds of 30 species were estimated. Surveys were conducted in 1990 on 14-15 April and 8-9 September. The study was expanded to cover many new sites including all major coastal wetlands in California from Humboldt to Morro bays, many wetlands in northeastern California, and the San Joaquin and Sacramento valleys.

San Francisco Bay continued to produce the highest shorebird counts, peaking in spring, but also supporting hundreds of thousands in fall and winter. Western sandpipers were the most abundant species and dunlin exceeded 100,000 in the spring. Other species found in excess of 10,000 were predominately in San Francisco Bay, including black-bellied plovers, American avocets, willets, marbled godwits, least sandpipers, dowitchers, and red-necked phalaropes. More results will become available in 1991. This project will continue for several more years.

c. Distribution and abundance of waterfowl in San Francisco Bay:

Refuge Biologists

We concluded field work for a cooperative study with the Northern Prairie Field Research Station - Dixon that began in October 1987. Our role was to conduct monthly aerial waterfowl surveys of the entire Bay and refine methodology in preparation for more intensive surveying (twice every month) to be conducted in 1988-90. Louise Accurso coordinated the survey effort, and in fall 1988, she began work on this project for her Master's thesis as a cooperative education student. Surveys were conducted twice monthly from September 1988 through April 1989, and again October through early April 1990. Loran coordinates were used to identify transects, and coordinates were continuously recorded by computer in the plane, which will make it possible to accurately map bird distribution. Little is known about seasonal change and distribution of waterfowl in the Bay estuary. This study will provide us with a foundation of knowledge, essential for improving management of waterfowl habitat. Some preliminary results are reported in Section G.3.

d. California gull chick diet in south San Francisco Bay:

Jan Dierks - Masters Degree candidate at Moss Landing.

The summer of 1988 served as the second field season for this two-year study conducted on the Knapp Unit. A few follow-up surveys were conducted in 1989. Field methods included the collection of chick regurgitations and general observations of adult and chick interactions throughout the day. Dierks completed her thesis in 1990. She found chick diet by volume to consist of 40% garbage, 15% midges, 15% brine shrimp, 13% fishes, and 10% brine flies. Young chicks (less than 10 days) were fed more brine flies than older chicks. Adult males were present more than females (65 vs 48% of the time), and parental attendance was similar to or greater than at other colonies. She concluded that food was readily available to these gulls and nearby dumps provided an important food source.

e. California least tern use of post-breeding foraging areas in the San Francisco Bay area:

Laura Collins - Field Biologist under contract with the California Department of Fish and Game.

The study originated in 1985 and continued through 1990. The results indicate the least terns are using low salinity salt ponds in the far south bay during the late summer months. Adult least terns were observed foraging in ponds A9, A10, A11, and A14 on the Refuge (Section G.2.C).

f. Warm Springs Marsh Restoration:

John Williams and Philip Williams - Hydrologists, Philip Williams and Associates, San Francisco, CA.

This three-year project involved a detailed monitoring plan designed to measure channel erosion and deposition, deposition in the embayment, and changes in the local tidal hydrodynamics. The 250 acre study site is located on the Refuge in south San Francisco Bay (Section F.2). A preliminary report indicates sedimentation rates as high as 4-6 feet per year within the embayment. A large segment of the open water area will eventually fill in within the next 10-20 years. A final report is expected in 1991.

g. San Francisco Bay contaminant monitoring study:

Refuge Biologists

The Refuge was funded again in FY 1990 to continue monitoring contaminants on refuges in the complex. (Studies for each refuge program are described here rather than under each refuge

individually). This was the fifth year of the program which was initiated in 1986 as a result of the Threats and Conflict identification process conducted in the mid-1980s. Potential threats identified by this process included agricultural runoff at Salinas River, industrial discharges, urban and/or agricultural runoff at San Francisco and San Pablo bays, and landfill leachate at Humboldt Bay. The program objectives have been to identify contaminants, the levels at which they occur, and areas of concern to refuge fish and wildlife. Sample collections this year included bivalves, sediments, aquatic invertebrates, and eggs from black-crowned night-herons, snowy egrets, and several species of waterfowl.

Bivalves (Macoma balthica) were collected in several areas from San Francisco Bay NWR and San Pablo Bay NWR including sites affected by the Shell oil spill which occurred in March 1988. Samples had been collected from these locations prior to the spill and have been collected periodically in order to determine the exposure and long-term fate of the hydrocarbons associated with this spill. Spring 1990 was the last collection of the samples associated with the spill. Data analysis will begin upon receipt of the final chemical results. It appears that it has taken two years for hydrocarbons in Macoma to return to their pre-spill levels. After two years the sample site that was hardest hit with oil, has not supported any Macoma since the spill. Macoma were also collected at sites where waterfowl have been collected for contaminant analysis in the past by Region 8 personnel. This cooperative study was initiated to determine potential routes of contaminant uptake in wintering waterfowl, by examining the relationship between levels of contaminants in waterfowl and the bivalves that form an important part of their diet. These same sites also serve as long-term sample sites to monitor trends in contaminant concentrations.

Black-crowned night-heron and snowy egret eggs were collected from the Mallard Slough colony in 1990. Only night-heron eggs were collected in 1989. These collections were done in conjunction with monitoring and collections at several other sites in the Bay by personnel from Patuxent Wildlife Research Center. This collaborative study involves investigation of the effects of contaminants on night-heron and egret reproduction. In addition to eggs from Mallard Slough, reproductive data and eggs for contaminants analysis have been collected from colonies at Bair Island and West Marin Island. West Marin and parts of Bair Island are under consideration for acquisition. Preliminary results show that hatchability was generally good at all sites, though some signs of impaired reproduction were observed (i.e., crushed eggs). Though mean contaminant levels in general are lower than those considered to cause reproductive impairment, some individual eggs have concentrations above those found to impair reproduction. Even though selenium levels at the moment may not be biologically significant, there may have been an

increase in mean egg selenium levels between the same colonies from 1982-83 to 1989-90. While there does not appear to be a net increase in organochlorine or PCB levels, it also does not appear that they have decreased significantly during the 7 year period either. Preliminary results are being put together for a presentation at the Western Section-The Wildlife Society meeting February 7-9, 1991, in Sacramento, California. (See Section D.5.p below).

We initiated the first look into potential contaminant impacts to wildlife from salt ponds this year. Salt ponds comprise the largest habitat type by area on the Refuge. Water quality in the south bay tends to be the poorest in the bay due to lack of circulation, reduced freshwater inputs and discharges from municipal and industrial treatment facilities. This water is then taken into the ponds and evaporated over the course of five years to make salt. With the premise that the water taken into the ponds is already of poor quality and concentrating it over five years would make it worse, we collected brine shrimp (Artemia franciscana) and waterboatmen (Corixidae) from saltponds in the Alviso, Mowry and Newark units. Results are pending.

Sediment samples were collected along the Southern Pacific Railroad right-of-way that runs through the middle of Dumbarton Marsh. Dumbarton is one of the largest tidal salt marshes in the south by and important habitat for the endangered California clapper rail. During bridge construction and renovation some years ago most of the debris from the old bridge was deposited along the railroad grade. A lot of this material has since fallen into the adjacent marsh. Most of the debris is lumber treated with creosote. Chemical analysis of the sediment samples have shown elevated levels of hydrocarbons. Some hydrocarbons are at concentrations that are as high as those reported in the literature from sites considered to be creosote contaminated. We are in the process of writing a report to present to Southern Pacific Railroad in hopes of convincing them to at least initiate a clean-up of the debris.

We initiated a study at Salinas River to investigate waterfowl reproduction in conjunction with contaminant exposure. Waterfowl nests were found and monitored on a weekly basis. One egg was removed from each nest for chemical analysis. We found more nests than we anticipated given the small size of Salinas River NWR and the lack of suitable nesting habitat. Unfortunately, nest predation was high so we were not able to collect good egg hatchability data. Chemical analyses of the eggs show waterfowl are picking up a variety of organochlorines, though analysis of the data has not yet been done to interpret the impacts. Sediment samples collected from the river did not detect any organochlorines at all, leaving us to wonder where waterfowl are being exposed to these contaminants.

- h. Trace element and organochlorine levels in California clapper rail eggs by David G. Lonzarich, Thomas E. Harvey, and Jean E. Takekawa.

This paper was released to the public in June 1990. Results were cited before the California Regional Water Quality Control Board-San Francisco Bay Region by local environmental groups and Region 8 personnel in a recent hearing. The board is looking into setting new selenium criteria for discharges from north bay refineries. The paper was originally sent to the Journal of Wildlife Management, presently it is being reformatted for submission to Archives for Environmental Contaminants and Toxicology.

Concentrations of trace contaminants were measured in California clapper rail eggs (Rallus longirostris obsoletus) collected from San Francisco Bay during 1975, 1986, and 1987, and in clapper rail eggs (R. l. waynei) from North Carolina during 1987. Residue of organochlorine compounds were low and decreased by two to three-fold from 1975 to 1986-87 for San Francisco Bay samples, whereas eggshell thickness remained unchanged. Mercury concentrations in eggs from three San Francisco Bay locations were higher than those from North Carolina, and similar to levels associated with reproductive effects in other avian species. Selenium concentrations in eggs from San Francisco Bay were higher than those from North Carolina, and were highest in a marsh adjacent to a north San Francisco bay oil refinery. Individual selenium concentrations were only slightly lower than values associated with embryo toxic effects in other rallids. Additional research to investigate the effects of these and other contaminants on clapper rails in San Francisco Bay is recommended as well as the restoration of additional rail habitat.

Manuscripts covering contaminants in waterfowl eggs and waterfowl tissues from San Francisco Bay are in draft form and several others are in preparation.

- i. Effects of contaminants on reproduction by wading birds in San Francisco Bay

Roger L. Hothem, Kirke A. King, Russel Stein, Patuxent Wildlife Research Station, Pacific coast Research Station
Douglas L. Roster, San Francisco Bay National Wildlife Refuge

This study was a cooperative effort between personnel from Region 8 and the Refuge. Preliminary results will be presented at the Western Section-The Wildlife Society meeting in Sacramento, CA in February, 1991.

During 1989 and 1990, nests of snowy egrets and black-crowned night-herons were monitored on Bair and West Marin islands; nests were also monitored on Brooks and Alcatraz islands in 1990. In

addition, eggs for chemical analysis were collected from Mallard Slough. The primary objective of the study was to determine the effects of contaminants on the reproductive success of these two species. Nests were located and monitored throughout the nesting period, and sample eggs were collected from each site for chemical analyses. Although hatchability appeared to be generally good at all four islands, signs of impaired reproduction, including crushed eggs and deformed embryos or chicks, were observed both years. Such reproductive impairment could indicate the presence of contaminant "hotspots" in San Francisco Bay. Because night-herons are acquiring their contaminant burdens from the local Bay area, but the actual locations of these contaminated sites are not known. Results of the analyses of eggs from Bair and West Marin islands in 1989 and 1990 indicate levels of contamination by organochlorine pesticides and PCB's similar to those observed in 1982 and 1983, even though their use has been banned or severely restricted for many years. Results of analyses for metals indicate that concentrations of certain metals are elevated. And while they are generally lower than those levels found to cause reproductive impairment, it appears that average levels may have increased since 1982 and 1983.

j. Breeding density, nesting habitat, and predators of the California clapper rail:

Refuge Biologists

This management-related investigation was initiated in 1989 in response to declining numbers of clapper rails observed during our non-breeding season surveys. Several aspects of the rail population in the Refuge were investigated, including:

1. The distribution and abundance of clapper rails in refuge marshes.
2. The number of rail nests, hatching success, and nest success in refuge marshes.
3. The distribution, abundance, and impact of predators on clapper rails.

The results of the investigation were documented in a refuge report titled, "Breeding density, nesting habitat, and predators of the California clapper rail," by Kevin Foerster, Jean Takekawa, and Joy Albertson in February 1990. The material was also presented in February 1990 during a poster session at the annual meeting of the Western Section of The Wildlife Society in Reno, Nevada (Section G.2.d.).

k. San Francisco Bay harbor seal monitoring project:

Diane Kopec, Lyman Fancher, James Harvey, and Sarah Allen.
Romberg-Tiburon Center for Environmental Studies.

This is an intensive three-year study of the harbor seal's population biology, movement patterns and reproductive success with a non-lethal monitoring program assessing the accumulation levels of toxic pollutants in the population. The study includes the use of radiotelemetry and blood sampling for contaminant analyses. A summary is included in Section G.9. The final report will be prepared in 1991.

l. California clapper rail breeding survey and salt marsh harvest mouse trapping, south San Francisco Bay:

Michael Rigney, Penelope Delevoryas, Rick Hopkins, Ron Duke and H. Thomas Harvey, H.T. Harvey & Associates, Ecological Consultants, Alviso, California.

The San Jose/Santa Clara Water Pollution Control Plant (SJ/SCWPCP) discharges up to 150 million gallons a day into south San Francisco Bay. Since 1970, the discharge has resulted in the conversion of approximately 275 acres from salt marsh to brackish marsh. This conversion has impacted two salt marsh dependent species, the California clapper rail and the salt marsh harvest mouse.

In response to the marsh conversion, the Regional Water Quality Control Board has required the SJ/SCWPCP to compensate for the loss. In turn, the SJ/SCWPCP hired biological consultants to study the impact. H.T. Harvey & Associates was retained by the City beginning in 1989 to study the breeding density of clapper rails in selected marshes near the SJ/SCWPCP discharge point. Survey techniques were standardized with those developed by San Francisco Bay NWR biologists. The rail surveys were complemented by a photointerpretation of existing marsh vegetation.

In April and May 1989, 44 pairs were detected. The highest rail numbers in this study were found in Triangle Marsh and the adjacent Goose Point Marsh. Clapper rails made highest use of areas containing cordgrass or cordgrass mixtures. The investigators suggest clapper rails may also be using portions of the brackish marshes during the breeding season. The conclusion is not supported by the data. A final report is on file at the refuge office.

In 1990, salt marsh harvest mouse trapping was conducted in the same marshes. Dr. Howard Shellhammer and Dr. Johanna Foster led this portion of the study. Six sites were trapped during three seasonal censuses, with 100 traps set per site for five nights. Animals were tagged and released. Vegetation was characterized

at each site. They trapped 126 salt marsh harvest mice in 1400 trap nights at Calaveras Marsh and 45 mice in 2000 trap nights at Triangle Marsh. The number of mice trapped per trap night at Calaveras Marsh is one of the highest recorded.

m. Contaminant effects on small mammals at San Francisco Bay:

Dr. Don Clark, U.S. Fish and Wildlife Service - Patuxent Wildlife Research Center, in cooperation with the refuge biologists.

The objective of this study is to determine whether small mammals in the salt marsh habitats of San Francisco Bay demonstrate adverse reproductive or histopathological effects associated with environmental contaminants. Small mammals were live-trapped and collected in 12 salt marshes throughout the entire bay during July 1989. Extreme caution had to be exercised during all trapping events because of the presence of the endangered salt marsh harvest mouse (Reithrodontomys raviventris). A total of 39 house mice (Mus musculus), 26 deer mice (Peromyscus maniculatus), and 12 California voles (Microtus californicus) were collected for chemical and/or histopathological analysis. A final report will be prepared in 1991 in the form of a scientific publication.

n. Ecological analyses along marsh environmental gradients:

Dr. Christopher Kitting, California State University Hayward, Hayward, CA

Dr. Kitting operates a marsh research station on the Refuge under a cooperative agreement. The marsh objectives of Dr. Kitting's on-going research are:

1. Determine spatial and temporal changes in vegetation and animals that parallel changes in exposure to seawater versus air throughout the range of intertidal height.

2. Monitor experimentally-induced changes in small-scale cores transplanted up and down intertidal gradients, as an indication of factors that limit natural zonation.

3. Test small-scale impacts on each zone due to hypothetical consumers, which are concentrated in small plots artificially (horn snails and mud snails) and/or examined for fecal contents.

Small litter bags were placed along the border between pickleweed and cordgrass. Results to date indicate that the most common invertebrate in the area was (Hyale plumulosa). To a smaller degree, other amphipods (Transorchestia transkiana and Corophium spp.) and isopod crustaceans also invaded the litter bags. Habitat selection by colonizing amphipods changed seasonally.

o. Taxonomic distinction of the salt marsh yellowthroat:

Dr. L. Richard Mewaldt, Coyote Creek Riparian Station.

Dr. Mewaldt began work to investigate the uniqueness of the salt marsh yellowthroat (Geothlypis trichas sinuosa) relative to other subspecies in the Bay area. His work was a contract study with the USFWS Enhancement Office in Sacramento. Results will be used to better determine whether the subspecies warrants listing.

Methods included the mist-netting, banding, and measurement of yellowthroats in refuge marshes. Two flight feathers were collected from each bird and a limited number of voucher specimens were collected. The study will be completed in 1991 and a report written by 1992.

p. Systematics of the San Francisco salt marsh yellowthroat.

Karen Raby, Antioch University, Yellow Springs, Ohio.

Karen Raby began her Master's research examining insect food sources for nestlings, habitat use, and male song as a population identification mechanism. She began preliminary work conducting breeding surveys and nest searches in refuge marshes. Field work will be completed in 1991 and a final report written thereafter. Refuge staff provided guidance in study design and site location.

q. Artemia population dynamics at the San Francisco Bay salt ponds.

Dr. Patrick Sorgoloos, Laboratory for Aquaculture and Artemia Reference Center, State University of Ghent, Belgium.

Dr. Sorgoloos began a study on brine population dynamics in refuge salt ponds. He was contracted to conduct this study by San Francisco Bay Brand, a brine shrimp harvester on adjacent Leslie Salt Company ponds. They formerly also held a contract to harvest shrimp on the Refuge, but they were replaced in 1987 by another contractor, Novalek. Bay Brand subsequently sued the Service. Sorgoloos collected water and shrimp samples in 1990 and results will be submitted in a final report in 1991. Sorgoloos was denied access to conduct research in some refuge ponds, per lawsuit settlement language that the two contractors would work in separate pond systems (Section D.4).

r. Contaminants in selected South San Francisco Bay marshes:

Dr. Brenda Sanders and Dr. Ken Jenkins, Jenkins, Sanders and Associates, Woodland Hills, CA.

This contract study was designed to investigate the presence of contaminants at a Superfund site in East Palo Alto (Rhone-

Poulenc). Refuge marshes (Ravenswood and Dumbarton) were used as comparison sites for the area of concern. Methods included vegetation characterization, salt marsh harvest mouse trapping, and soil and plant collections for contaminant analyses. They trapped six salt marsh harvest mice in 500 trap nights in Dumbarton Marsh.

E. ADMINISTRATION



Back row - left to right: Jan Armigo Brown, Office Automation Clerk; Carolyn Wang, Administrative Support Assistant.

Front row - left to right: Stephen Berendzen, Refuge Operations Specialist; Richard A. Coleman, Project Leader; Joan Dawson, Office Automation Clerk.

1. Personnel

PERSONNEL

1. Rick Coleman - Project Leader; GM-13, PFT
2. Ben Crabb - Assistant Project Leader; GS-12, PFT
3. Stephen Berendzen - Refuge Operations Specialist; GS-11, PFT
4. Eric Nelson - Refuge Manager; GS-9, PFT
5. Carolyn Wang - Administrative Assistant; GS-7, PFT
6. Janice Armigo Brown - Office Automation Clerk, GS-4, PFT
7. Joan Dawson - Office Automation Clerk, GS-4, PFT
8. Jean Takekawa - Wildlife Biologist; GS-11, PFT
9. Kevin Foerster - Wildlife Biologist; GS-9, PFT
10. Douglas Roster - Wildlife Biologist; GS-9, PFT

PERSONNEL (continued)

12. Louise Accurso - Coop. Ed. Student (Wild. Bio.); GS-7, PPT
13. Joy Albertson - Biological Tech. (Wildlife); GS-5, PFT
14. John Steiner - Outdoor Recreation Planner; GS-11, PFT
15. Frances McTamane - Environmental Education Specialist;
GS-11, PFT
16. Sheila McCartan - Interpretive Specialist; (Volunteer
Coordinator); GS-9, PFT
17. Thomas Banks - Park Ranger; GS-7, PFT
18. Paul Wong, Interpretive Specialist, GS-7, PFT
19. Evgenia Drakoulis - Park Ranger; GS-5, TPT
20. Jim Ferrier - Police Officer; GS-7, PFT
21. Jon Adamson - Police Officer; GS-7, PFT
22. Bob Bolenbaugh - Police Officer; GS-7, PFT
23. Barry Tarbet - Police Officer; GS-7, PFT
24. Steve Lewis - Maintenance Worker; WG-8, PFT
25. Mike Bitsko - Maintenance Worker; WG-8, PFT
26. Thomas Lievsay - Maintenance Worker; WG-8, PFT
27. Beth McCoy - Maintenance Worker; WG-5, TPT

The following personnel changes/actions occurred during 1990:

<u>Name</u>	<u>Position/Grade</u>	<u>Action</u>
Joy D. Albertson	Biological Technician GS-0404-05	Conversion to appt. NTE one year 08-13-90
Thomas Banks	Park Ranger GS-0025-05 to GS-0025-07	Promotion 07/29/90
Thomas Banks	Park Ranger GS-0025-07	Resignation 12-15-90
Stephen Berendzen	Refuge Manager GS-0486-09 to GS-0485-11	Promotion 07-15-90
Stephen Berendzen	Refuge Operations Specialist	Change in Title 12-02-90
Janice A. Brown	Office Automation Clerk GS-0322-04	Recruit 02/5/90
Ben H. Crabb	Refuge Manager GS-0485-12	Retirement 11-30-90

Name	Position/Grade	Action
Evgenia Drakoulis	Park Ranger GS-0025-05	Resignation 02-23-90
Sheila McCartan	Interpretive Specialist GS-0025-07 to GS-0025-09	Promotion 07-29-90
Eric Nelson	Refuge Manager GS-0485-07 to GS-0485-09	Promotion 03-25-90
Douglas L. Roster	Wildlife Biologist GS-0486-09	Conversion to Career Conditional 11-04-90
Carolyn Wang	Admin. Support Asst. GS-0303-07	Transfer/Promotion 01-28-90

<u>Permanent</u>			<u>Temporary</u>	
<u>FY</u>	<u>Full Time</u>	<u>Part Time</u>	<u>Full Time</u>	<u>Part Time</u>
90	23	1	2	
89	23	1	3	
88	24	1	4	
87	20		3	1 (HBNWR)
86	19		1	(HBNWR)

2. Youth Program

B. Boy Scouts/Girl Scouts

During 1990, the Refuge had 8 employees involved with the Boy Scouts of America. A total of 857 hours, consisting of 472 hours of duty time and 385 hours of volunteer time, were logged.

Staff members were involved with the completion of five Eagle Scout Projects and served as merit badge counselors (Rifle Shooting, Finger Printing, Nature, Bird Study, Safety, Soil and Water Conservation, Fishing and Fish & Wildlife Management). A 7-hour class was conducted for Environment and Conservation Skill Awards. One staff member assisted two scouts as their Hornaday Award Advisor and served as an Assistant Scoutmaster, Committee Chairman and Explorers Advisor. The Refuge sponsors a cub pack, Boy Scout troop, and Explorer's Post.

The Refuge's Conservation-Natural Resource Explorer Post held its third successful open-house on October 10th. Approximately 50 youth and parents attended resulting in 26 youth registering. The group participated in field trips, one to Ano Nuevo State Park (elephant seals), and the other to Monterey Bay Aquarium before the year's end. Both were organized specifically for the Post.

We cooperated and worked with the Girl Scouts for the first time this year. A total of 78 staff hours and 52 volunteer hours were logged, mostly during the late summer.

4. Volunteer Program

The San Francisco Bay NWR volunteer program continued to be successful during 1990, with both the Service and the individual volunteers benefiting during the course of the year. Trained Refuge volunteers donated approximately 16,568 hours of time to the Service. Fewer total SCA internships held at the Refuge because of lack of available funding contributed to 1000 fewer volunteer hours in 1990 over 1989.

The Refuge had nine interns through the Student Conservation Association program (SCA) in 1990 who contributed 4055 hours to Refuge programs. These hours are included in the total volunteer hours.

The non-SCA volunteers saved the government more than \$94,145,00 in wages alone (based on the salary of a GS-7 employee). The number of active volunteers varied from 56 to 62 during the year, with a total number of 117 individuals contributing time. This number reflects only those people who are trained Refuge volunteers and not those individuals who volunteered but are not considered "official" Refuge volunteers. At the close of the year, there were 110 active Refuge volunteers. Though volunteers are requested to donate at least 16 hours per month, individuals actually donated from 0 to 72 per month. The "non official" volunteers numbered 682 and worked mostly on one-time projects at this Refuge and the Satellite Refuges. They contributed 14,780 hours making a grand total of 31,348. Contribution in time by all Refuge volunteers (excluding SCA interns) was the equivalent dollar amount of \$303,449 (based on the salary of a GS-7 employee). The groups included boy scouts, girl scouts, school groups and California Conservation Corps, to name a few. These groups worked mostly on maintenance and resource management type projects as well as clean-up projects such as Coast Clean-up Day.

Volunteers (including SCA interns) were involved in a variety of tasks and projects, including interpretation and education, biological research and habitat management, maintenance work and administrative support. Approximately 61% (10,100 hours) of volunteer time was spent in the interpretive and environmental

education division; 7% (1160 hours) was spent with the biology division on resource management; 13% (2160 hours) was spent on administrative support; 14% (2320 hours) was spent on maintenance projects and 5% (830 hours) to miscellaneous projects. Volunteers were involved in the following:

Interpretation. Volunteers staffed the Visitor Center information desk and book sales area, and accounted for 98% of the fixed duty hours in the Visitor Center. Due to this valuable donation of time and effort by our volunteers, we were able to keep the Visitor Center open to the public seven days a week, 362 days of the year. Volunteers patrolled Refuge trails and spoke with hikers, birders, fishermen and joggers that they encountered. During these patrols, they took visitor censuses for our public use reports, made note of any needed maintenance, picked up litter and watched for signs of vandalism.

Throughout the year, volunteers led and assisted in the presentation of most (99%) of our weekend interpretive programs, including walks, slide shows and tours. Volunteers were largely (99%) responsible for a popular van tour of the abandoned ghost town of Drawbridge and tours of satellite refuges. We presented monthly canoe and bike trips, photo hikes and evening astronomy programs for Refuge visitors thanks to the efforts of our volunteers. Without our Refuge volunteers, many special programs such as "Kids Day," "Open Houses," "Earth Day," two "Wildlife Art Shows," "Native Plant Sale," "Marshlands Art Academy" and "Halloween Open House" would not have been possible. Volunteers also staffed information booths at various community and environmental fairs. Without their efforts many people would not know about the Refuge or the Service.

Volunteers also helped in the development and production of several new Refuge brochures including a revised edition of the butterfly species checklist. By the end of the year, other publications such as an endangered species brochure and a Tidelands Trail Topic on seashells were well underway.

Many volunteers contributed time to the operation of the San Francisco Bay Wildlife Society serving as board members, assisting with memberships, and helping in a variety of ways with the bookstore sales outlet. Volunteers wrote articles and edited the Tideline newsletter and managed the mailing list of 16,000. They hand labeled the addresses for the quarterly mailings. We would not be able to produce the Tideline, a valuable source of public outreach and education, without volunteer assistance.

Environmental Education. Volunteers played a significant role in the operation and continued development of the Refuge Environmental Education program at both the Environmental Education Center and the Visitor Center. Volunteers helped with teacher orientations, field trips, and classroom presentations.

The summer Marsh-In Camp and the summer Junior Naturalists program were almost entirely volunteer organized and run. These programs could not have taken place without volunteers.

Resource Management. Volunteers lent a helping hand with surveys and censuses such as the Aleutian Canada Goose and clamming projects. In addition, a number of work parties occurred throughout the year at two of our satellite refuges. Volunteers helped with exotic species removal (plants) and revegetation at Antioch Dunes NWR. During the Coast Clean-Up Day, a large group of volunteers helped remove garbage from the Shoreline Trail and several other areas on the Refuge.

Administrative Support. Volunteers provided many staff with administrative help through time spent on various projects such as filing, photocopying, record keeping, and computer data entry.

Maintenance. Volunteers worked with the maintenance staff on projects such as painting and routine maintenance of buildings, vegetation removal and control, trail maintenance and construction and building construction.

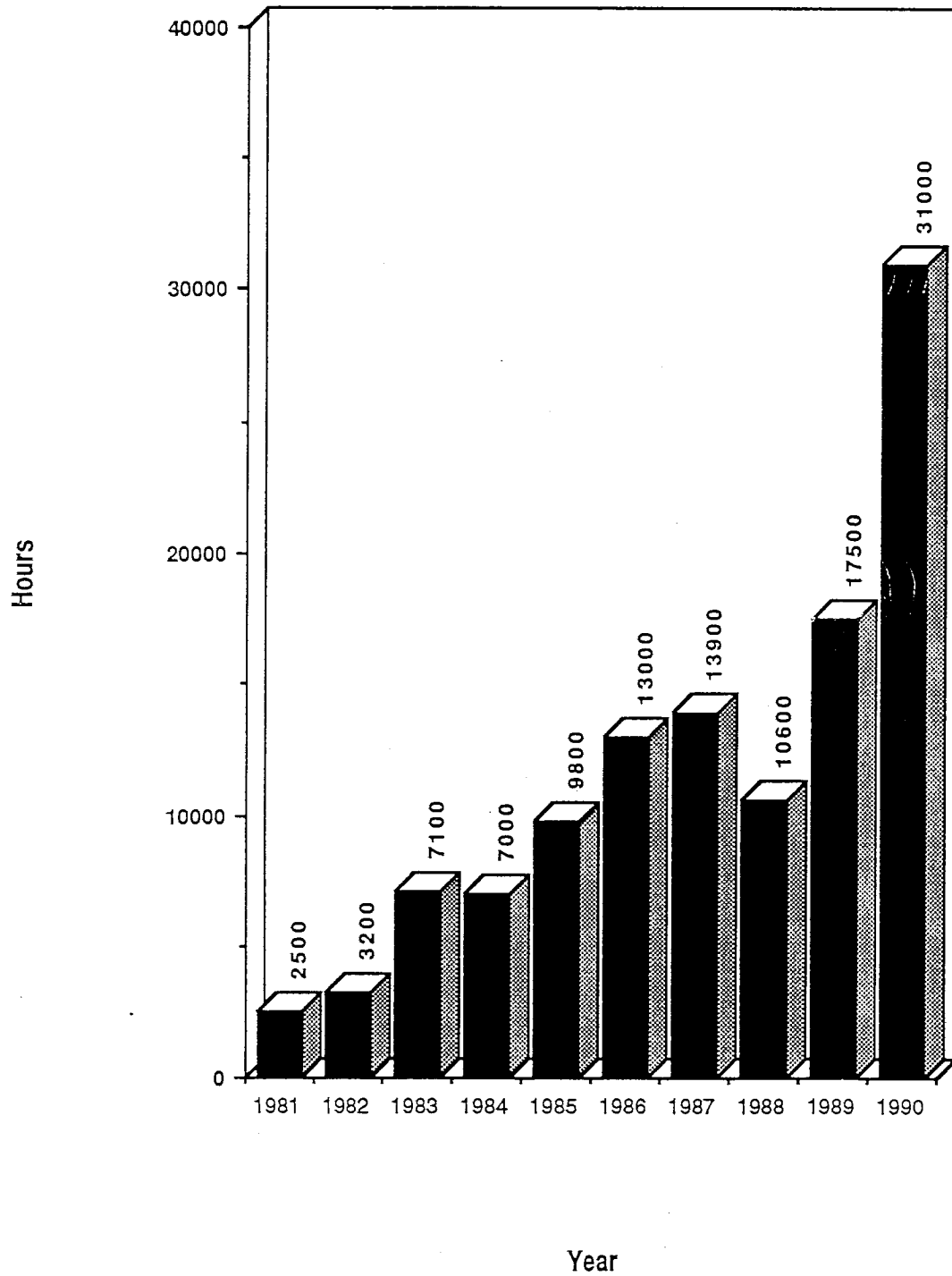
Student Conservation Association Interns. During the course of 1990, nine full-time 12-week appointments were filled with volunteers through the Student Conservation Association. In exchange for their full-time volunteer services, the Refuge provided them with housing and a small subsistence of \$50.00 per week. The interns worked primarily with the biologists and the environmental education program. The SCA interns are an invaluable asset to the Refuge program. They have provided us with professional and quality work. It is always enjoyable to work with them.

One advantage of the location of an urban wildlife refuge is that there is a large population base located nearby that serves as a vast reservoir of potential volunteer candidates. The Refuge is able to have a successful program, because normally there are adequate numbers of interested people on our waiting list to replace those volunteers who drop out of the program. We recruit new people through displays at various off-site information fairs in which the Refuge participates, word of mouth advertising, and articles in the quarterly Tideline newsletter. An application/brochure which describes the volunteer program is available in the Visitor Center, and is given to those prospective volunteers who see it and ask for it. We conducted three 20-hour training and orientation sessions in 1990. A total of 48 people completed the training and became official Refuge volunteers.

In June, Refuge volunteers were recognized for their efforts at the Eighth Annual Awards Banquet. The Refuge staff organized a picnic and they barbecued chicken and steak (with funding coming from the SFB Wildlife Society). A great time was had by all!

All the volunteers received Certificates of Appreciation. Seven outstanding volunteers, who donated the most time throughout the year received special recognition and a gift purchased by the San Francisco Bay Wildlife Society. For the first time, there were awards given to the staff who had demonstrated unusual and outstanding efforts in their work with volunteers and the volunteer program. This was the fifth year the Refuge gave a "Volunteer of the Year Award." Lee Lovelady, who contributed the most hours (574) received the award this year.

Volunteer Hours -- San Francisco Bay NWR



Farallon N.W.R. hours not included, 1981-1989



The marshes around the Refuge were once again free of debris after 300 enthusiastic volunteers worked tirelessly all day during our annual Coast Clean-Up Day.



Volunteer of the year, Lee Lovelady, prepares a group at the Environmental Education Center for a lesson on owls and owl pellets.

6. Safety

Due to the compilation of the 1990 narrative report in May, 1993, a turnover in staff at the level of Assistant Project Leader and Administrative Assistant with the associated purging of files, records of the Safety events for calendar year 1990 are unavailable.

8. Other Items

Leslie Salt Company utilizes the ponds on the Knapp Tract, Alviso Unit, as a part of their production cycle. The annual fee to the Service for the use of this 452 acre tract is \$4,500.00.

The three pay phones located on the Refuge continue to generate approximately \$70.00 - \$75.00 per year.

Revenue sharing payments totaling \$67,921.00 were paid as follows: Alameda County \$40,755.00; Santa Clara County \$22,010.00; and San Mateo County \$5,156.00. This represents % of the total amount authorized.

Novalek, Inc. is a commercial brine shrimp harvester under contract with the Refuge for the five year period 1988-1992 to harvest brine shrimp in the Plant Number 2 salt ponds. They harvested 250,268 pounds of brine shrimp and 5,755 pounds of brine shrimp cysts in FY 1990, resulting in \$76,954 in royalty payments being paid to the Refuge.

F. HABITAT MANAGEMENT

2. Wetlands

The Refuge includes some of the largest remaining tracts of tidal salt marsh in south San Francisco Bay. These include Dumbarton, Mowry (North and South), Calaveras, Ideal, and Greco Island. Although most of these marshes were made much smaller by the creation of salt ponds in the late 1800s and early 1900s, they still retain the features critical to salt marsh dependent species. Many rare and endangered species depend on these marshes, including the California clapper rail, salt marsh harvest mouse, Alameda song sparrow, and salt marsh wandering shrew.

However, these marshes have been degraded by many human influences. Salt pond levees provide easy access to marshes for predators. Much of the high marsh has been lost to development, leaving marsh inhabitants with less refugia during extreme high tides and storm events. Rip rap along salt marsh levees creates fill in wetlands and provides cover for non-native predators

including rats and red foxes. Marshes are further impacted by contaminants from municipal and industrial sources.

Studies and management have been designed to address these impacts and to monitor the status of salt marsh dependent endangered species (Sections D.5 and G.2). The Leslie Salt Company provided its annual report of work to be done in salt ponds on the Refuge. Refuge staff provided comments to minimize impacts to wildlife, e.g., to adjust timing of work.

Active habitat management and restoration continued in several smaller parcels. Tract 102, 150 acres of former salt crystallizer ponds, continued to benefit from restored tidal action (in the early 1980s) and additional improvements made to facilitate water flow in 1988 and 1989. Management at this site, through circulation of tidal waters and freshwater runoff, provided foraging habitat for wintering shorebirds and waterfowl. Salt marsh vegetation has rapidly grown in ponds receiving the greatest tidal flushing. Knowledge gained in restoring these smaller areas will be useful in any future restoration of larger salt ponds.

Slow progress was made on the proposed enhancement of New Chicago Marsh, adjacent to our Environmental Education Center (EEC) in Alviso. This area, which historically supported tidal marshland, became isolated from the bay by the construction of the salt evaporation ponds during the 1920's. Introduction of bay water would improve water circulation and enhance the site for salt marsh harvest mice and wintering and breeding waterbirds. Funding for this enhancement will originate from fines that were levied against the City of San Jose for a series of sewage upsets at their Santa Clara Pollution Control Plant in 1979 and 1980. Peninsula Open Space Trust is responsible for disbursement of these funds, which may also go toward construction of a colonial bird observation tower near the EEC.

Refuge staff continued to manage five abandoned salt evaporation ponds south of Highway 84 and west of the headquarters/visitor center. By leaving a tide gate continually open, tidal access was restored to the first four ponds in the series. A wooden flap gate was installed at the entrance of the fifth pond allowing tidal waters to be held back and maintained at depths suitable for waterfowl, such as shoveler, ruddy duck and scaup. It was then drained in the spring to provide nesting habitat for snowy plovers.

In 1986, the Refuge acquired a 250 acre parcel of historic bay marshland, which was restored to tidal action as mitigation for construction of an approximately 400 acre industrial park in Fremont. Restoration of the area increased the volume of tidal water moving through the sloughs and creeks which enter the southern arm of San Francisco Bay. This will in turn facilitate

scouring and erosion of these channels, many which have become clogged by depositing silts and clays. The majority of the property consists of a large tidal pond, which by late fall supported several hundred ducks including scaup, canvasback, pintail, mallard, wigeon and cinnamon teal, and an occasional harbor seal. It was also a roost site for over 3,000 California gulls. In addition, the parcel included a 21.3 acre diked pickleweed marsh, to be managed for the endangered salt marsh harvest mouse. Two screwgates make it possible to introduce tidal water. However, when the 21.3 acre parcel was flooded in the spring of 1987, a major mosquito outbreak resulted. It then became necessary to drain the property and the local mosquito abatement district sprayed it with a biological control agent. Since that time, tidal water has not been introduced into the site. Instead, we have pursued a restoration plan that would allow manipulation of water levels, including the ability to lower water levels when necessary. Design options were explored, limited topographic information collected and coordination with the mosquito abatement district staff was accomplished. Funding to complete the project will be sought through various sources.

Habitat management options were explored in the Knapp property in Alviso, which is owned in fee title by the Refuge. Formerly leased and managed by duck hunters, the lease recently expired. The area is made up of four impounded cells with a well on-site. In the fall the pump was serviced and piping replaced and reconnected. Small amounts of fresh water were pumped into the cells to provide flooding for shorebirds and waterbirds. Difficulties were encountered in holding water due to seepage into the ground and through berms around the impoundments. Furthermore, no funding was available to pay for electricity or water costs, limiting pumping abilities. Management capabilities will be assessed at the end of the 1990-1991 winter season.

In September 1989, Pacific Gas and Electric Company (PG&E) caused damage in Triangle Marsh, a brackish marsh in the very south end of the Refuge. Without notifying the Refuge, they launched a tracked vehicle in the marsh in an attempt to replace power poles that serviced a Leslie Salt pump. They became stuck and caused gouging and damage in endangered species habitat (rails and salt marsh harvest mice). Through an agreement with the Refuge, PG&E agreed to repair the damage, train all workers in the sensitivity of the site, have a biologist on site for all future work, and keep all vehicles out of the marsh. Restoration work was accomplished in early 1990 and included restoring elevations to grade with native soils and replanting with pickleweed.

Pole replacement was scheduled for September, following these new guidelines. On September 24, a Refuge biologist accompanied PG&E to the site to reiterate these guidelines. Two days later, a PG&E employee drove an ATV through the pickleweed at the edge of the marsh, because he wanted to avoid the "bumpy" levee. Refuge

staff met with PG&E once again. The work was eventually accomplished without further mishap.

Several meetings were held with the City of San Jose, EPA, and other agencies to resolve the placement of asbestos-laden fill and 10 culverts near the Environmental Education Center in Alviso. These were placed there in 1983 during a flooding event to allow drainage of flood waters through New Chicago Marsh. The city proposed to cap the fill with asphalt to secure the asbestos. However, the Service (Refuge and Sacramento Enhancement) requested removal of the fill due to the high erosion potential at the site. Negotiations will continue in 1991.

The Refuge contains approximately 9000 acres of solar salt evaporation ponds operated by the Leslie Salt Company. Unfortunately, when the Service gained ownership of the ponds, we did not obtain management rights to the area. Since Leslie Salt may continue to harvest salt in the ponds in perpetuity, the Refuge has little input in management of the ponds. This arrangement is detailed in an 18 page agreement between the Service and Leslie Salt Company. In the eventuality that Leslie Salt may someday cease salt making operations, all management rights revert to the Service. Therefore, we have been conducting monitoring studies of the salt ponds to understand the biological processes of this unique habitat.

In tidal intake ponds and early series salt ponds, the water remains fairly clear, with salinities ranging from that of the bay waters to double the normal salinity. Widgeon grass grows profusely in these ponds attracting large numbers of waterfowl, including shoveler, pintail, gadwall and canvasback. Fish can also survive in these ponds and some species reproduce there. The common species are long-jawed mudsucker, three-spined stickleback, staghorn sculpin, topsmelt and others. These fish attract thousands of fish-eating birds, such as white and brown pelicans, double-crested cormorants, terns, herons and egrets.

As salinities increase in the solar salt pond series, algae and halophytic bacterial blooms occur, turning the water into various shades of brown, green, orange, pink, and red. The algae are fed upon by brine shrimp (Artemia sp.) which then undergo mass population blooms. Brine shrimp and brine shrimp eggs were harvested commercially on Refuge salt ponds via a contract inherited by the Service from the previous owner. During 1984, this contract expired and a temporary extension was given. In 1987, a contract was awarded to a new contractor, the Novalek Company. For the first time, the harvest of brine shrimp eggs (actually more lucrative than the sale of shrimp) was included in the contract, to insure that the federal government would receive revenues for this additional harvest. Also for the first time, two ponds were withheld from harvest to make it possible to

investigate the potential impacts that harvesting has on brine shrimp populations. The new company is more research oriented, and plans to do studies to learn more about brine shrimp biology and population dynamics. The new harvesting agreement should provide increased revenue and greater control over the harvest to the benefit of wildlife. Meanwhile, the former contractor, San Francisco Bay Brand, has sued the Fish and Wildlife Service (Section D.4). They continue to harvest shrimp in adjacent salt ponds in the South Bay under contract with the Leslie Salt Company.

Brine shrimp and invertebrates such as brine flies and water boatmen are extremely important to many migratory birds using the salt ponds. Scaup, ruddy duck, and bufflehead utilize this food source along with thousands of eared grebes, phalaropes, California gulls, black-necked stilts, American avocets, and other sandpipers and plovers. Our long range goals are to gain complete management control of the salt ponds and boost production of fish and invertebrates in the appropriate salt ponds for the benefit of migratory bird populations as well as commercial harvest, if compatible. Other salt ponds will be restored to tidal marsh to provide much more extensive habitat for several rare and endangered species.

9. Fire Management

In 1989, a prescribed burn was conducted on a one acre upland parcel on the Refuge headquarters hill. The purpose of the burn was to remove a dense stand of fennel (Foeniculum vulgare), an invasive, introduced plant. The area was revegetated in December by Refuge staff and volunteers. A variety of native plants including coyote brush, coast live oak, buckwheat, and stipa grass were planted. Refuge volunteer, Norton Bell, took the lead on maintaining the area through 1990, keeping the area relatively fennel free by removing plants mechanically.

No fires were reported on the Refuge in 1990.

G. WILDLIFE

2. Endangered and/or Threatened Species

a. California Brown Pelican

As in previous years, brown pelican use of south San Francisco Bay continued at a relatively low level compared to other areas on the central California Coast. Major use areas for this species include central San Francisco Bay, the Farallon Islands and Monterey Bay. Approximately 150-200 pelicans normally inhabit the salt ponds and open bay, both on Refuge lands and on adjacent property. High use areas were low salinity (30-45 ppt)

salt ponds where birds frequently display a rather atypical surface feeding behavior. Pond levees also provided roosting sites for this species.

b. American Peregrine Falcon

This species may be encountered year-round in south San Francisco Bay, however, most records occur during late fall and winter. The abundant shorebird and waterfowl populations utilizing San Francisco Bay during the winter and migrational periods provide a readily available prey base for this avian predator. Peregrines were occasionally sighted in the vicinity of the headquarters and Dumbarton Bridge. In early fall, peregrine falcons were observed foraging at the Dumbarton Railroad Bridge, Knapp Property, Palo Alto Baylands, and Tract 102.

c. California Least Tern

Management efforts for this species consist of improving the habitat and monitoring breeding effort at the primary South Bay colony. This colony, which was historically located on the dried surface of an abandoned salt pond near Redwood City, has not supported successful nesting for the past four years. Reasons for abandonment are not clear, but may be due primarily to encroachment by vegetation (Salicornia spp.) into the site and/or because Caspian Terns, which provide protection from raptor predation, also abandoned the site three years ago. Monitoring was conducted by volunteers with the San Francisco Bay Bird Observatory. The California Department of Fish and Game (CDFG), which owns the property, has expended considerable efforts in protecting the site from tidal inundation and is attempting to make it more attractive to terns. During 1987, they finished rehabilitation of levees surrounding the site, moved oyster shell onto the levees to provide suitable nesting substrate and built a nesting platform of shell. Caspian terns recolonized the site in 1987. The population peaked at 1700 birds in 1988, however least terns have not returned to nest.

A survey by researchers (D.5.e) showed that least terns forage in the lower salinity salt ponds in the South Bay during the late summer months. This post-breeding use includes adults and juveniles still being fed by adults and learning to forage on their own. The clear waters, shelter, and impounded fish populations provide important feeding and roosting habitat for these birds.

d. California Clapper Rail

The California clapper rail is extremely endangered and is now apparently restricted to the marshes of San Francisco Bay. Higher densities and more of the population (as many as 80%) are found in south San Francisco Bay. The most critical marshes for

clapper rails are found within the Refuge. A total population estimate of approximately 1,500 rails was derived in the early 1980s. However, since the mid-1980s the population has experienced precipitous declines in some South Bay marshes.

In 1989, we conducted a study to investigate causes of declining rail numbers. We produced a report titled, "Breeding density, nesting habitat, and predators of the California clapper rail," by Kevin Foerster, Jean Takekawa, and Joy Albertson in 1990 (Section D.5.h). Our methods included the use of call count surveys to derive breeding population estimates in selected South Bay marshes, nest searching and monitoring to determine reproductive success and causes of nesting failure, and extensive spotlight surveys for predators. We found that breeding densities (rails/ha) in selected marshes indicated a substantial decrease in the population when compared with previous studies. For example, densities in Dumbarton Marsh (0.64), Mowry Marsh (0.26), and Ideal Marsh (0.0) were much lower than had been found in the early 1980s (1.47, 0.89, and 0.69, respectively). Nest success was significantly lower (25% vs 56%, p less than .05) than a 1980 study in the same area by Harvey (1988) and substantially lower than the 81% success rate reported for light-footed clapper rails (Massey et al. 1984).

Twenty-four clutches were monitored including 155 eggs. Approximately one-third (51 eggs) were lost to predation and another 25% disappeared (which may have included eggs lost to red foxes). Of 43 eggs incubated to term, 65% hatched successfully. Contaminants may have contributed to the low hatchability. Previous refuge studies documented the presence of mercury and selenium in rail eggs from San Francisco Bay.

Non-native red foxes and feral cats were present in all surveyed marshes. Predators were abundant in Ideal Marsh and rats were identified as a major nest predator. Results of this study were also presented as a poster at the annual meeting of the Western Section of The Wildlife Society in 1990.

We conduct annual non-breeding population surveys in most marshes in the South Bay and selected marshes in the North Bay. Most surveys are done by airboat in extreme winter high tides (9.0 feet above mean lower low water) when the vegetative cover is minimal and rails are easily counted. A few surveys are conducted by ground observers or airboat surveys are sometimes supplemented by ground observations. This cooperative survey includes assistance by the California Department of Fish and Game, San Francisco Bay Bird Observatory, Sacramento Enhancement, and volunteers. During the winter of 1989-1990, we surveyed on nine days in November through January, using 1-2 airboats. We counted 321 individuals in 19 South Bay marshes and 33 in 7 North Bay sites. Rail numbers remained relatively stable in Palo Alto, on the west side of the Bay. However, rail numbers have declined

precipitously since the mid 1980s, particularly in the East Bay in some of the marshes supporting the largest subpopulations of rails. We estimated that the entire rail population may have fallen to 600 or fewer birds in 1990.

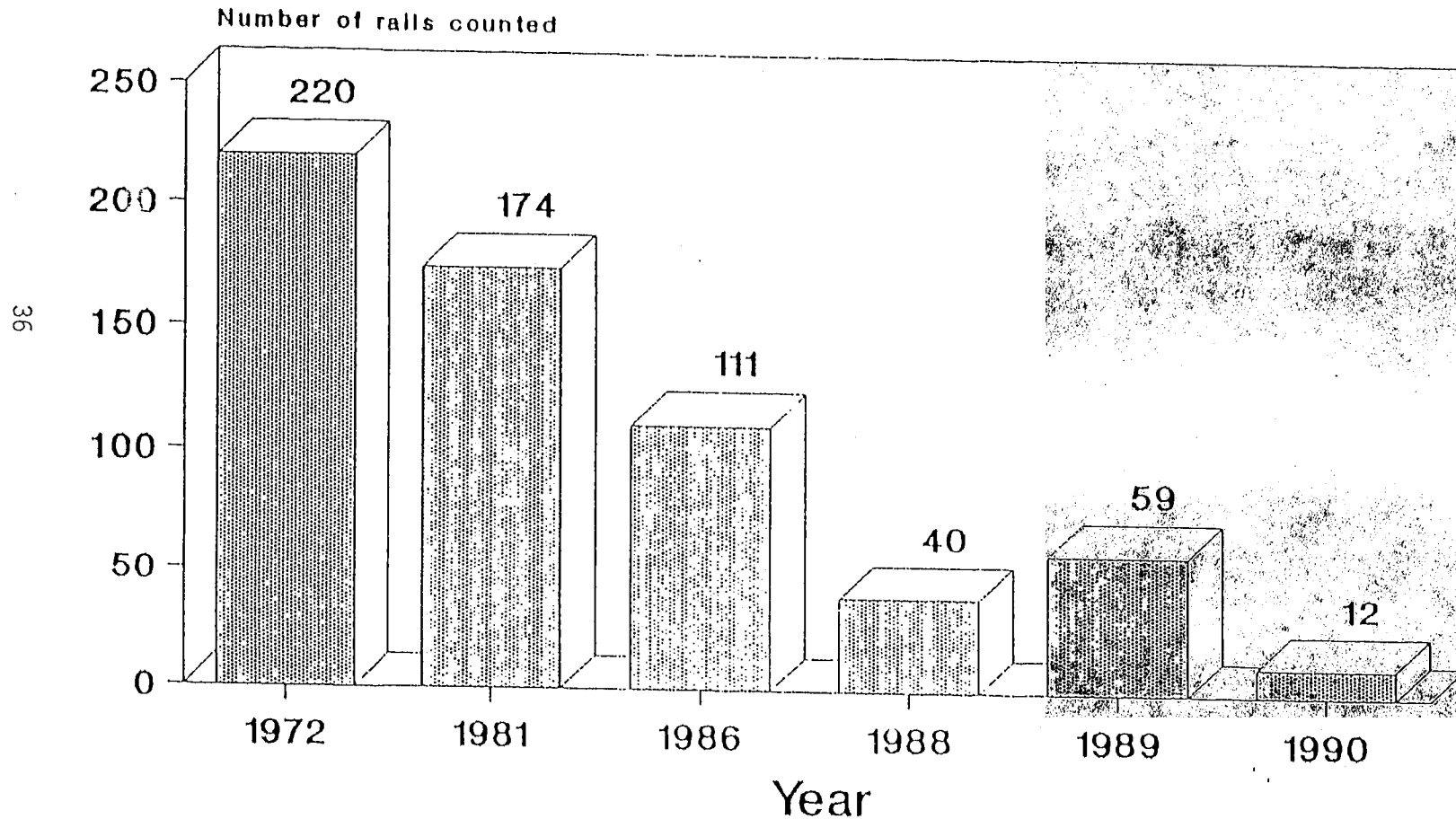
In November, 1990-91 surveys were initiated. Preliminary results indicated that precipitous declines continued in major marshes of the South Bay. For example, rail counts in Dumbarton Marsh, near Refuge headquarters, had dropped to 12 (75% coverage) by December 1990 (see graph). This marsh had traditionally supported as many as 200 or more rails, the largest number of rails in any marsh in San Francisco Bay. Declines were first detected in 1986 and subsequently the population has crashed. Similar declines were observed in Mowry Marsh (a large marsh south of Dumbarton Marsh). This marsh traditionally supported a large subpopulation of rails, second only to Dumbarton. An estimated 140-160 rails resided there in the early to mid 1980s. Winter surveys in 1989-90 produced a total of 70 rails and early results in 1990-1991 indicated further declines.

Ideal Marsh (north of Dumbarton Marsh) supported 19 breeding pairs in the early 1980s and a peak of 80 rails in winter surveys. Surveys in 1989 and 1990 indicated that only a few rails (2-3) remained.

The timing and locations of these declines coincide closely with the arrival, occurrence, and relative abundance of the non-native red fox. For example, prior to 1986 red foxes had never been seen in the salt marshes of San Francisco Bay during winter high tide rail surveys. In early 1990-91 winter surveys, biologists counted 6-8 foxes in Mowry and Dumbarton marshes while conducting rail surveys. The largest numbers of rails have been lost from these marshes. We conducted nighttime spotlight surveys for terrestrial predators during the spring and summer of 1989 and the spring of 1990. The highest numbers of predators were observed in Ideal Marsh, including red foxes, feral cats, raccoons, and skunks.

CALIFORNIA CLAPPER RAIL

Dumbarton Marsh



Complete winter high tide counts only.
1972 count may have been an estimate.
1990 count represents 75% coverage.



Several active red fox dens were found in tidal salt marshes, such as in these old spoils in Audubon Marsh, adjacent to Dumbarton Marsh. (JET)

Red foxes are now common in many of the wetland habitats of greatest importance to clapper rails, as well as salt marsh harvest mice, and colonial nesting ground birds. We regularly observed red foxes foraging in tidal salt marshes in all tidal conditions, including the peak of extreme winter high tides when rails and other wildlife are most vulnerable to predation. Red foxes are able to den in slightly upraised areas within tidal salt marshes and directly impact both rail eggs and adults.

Further evidence of the direct impacts of red foxes on clapper rails was discovered in April, when active red fox dens were discovered at the edge of Dumbarton Marsh and within the adjacent Audubon Marsh. Three California clapper rail carcasses were found outside of these dens, along with a variety of other bird remains. Red foxes were seen foraging in and along Dumbarton more frequently in 1990 than in previous years and rail declines accelerated during this period. Very limited call count surveys in 1990 indicated severe breeding population declines.



These rail remains, marked by a red fox scat, were found in April outside of an active red fox den along with two other rail carcasses. This was a banded rail that had been marked nearby in Dumbarton Marsh in 1985. (JET)

Based on our studies and surveys, we concluded that management efforts to protect the rail population were essential. Ideal Marsh supported few rails and further declines in Dumbarton and Mowry marshes could result in the loss of viable breeding populations within 1-2 years. New terrestrial predators were found in all marshes and nest predation was high. We concluded that the non-native red fox posed a severe threat to clapper rails and other ground-nesting species. Therefore, we prepared a draft environmental assessment and predator management plan to address these needs (Section G.15).

Other management efforts aimed at recovery of the rail included continued habitat acquisition (Section C.1), protection of habitat through existing regulations, habitat restoration projects (Section F.2), and expanded studies and monitoring.

e. Salt Marsh Harvest Mouse

The Refuge supports many important subpopulations of the salt marsh harvest mouse in the tidal salt marshes. In addition, mice can thrive in impounded areas that are sufficiently saline and support pickleweed stands, including New Chicago marsh where a sizable subpopulation exists. No refuge trapping studies were conducted in 1990, however, mice were trapped in Dumbarton and Ravenswood marshes by Jenkins and Sanders Associates (Section D.5.g). Additional trapping studies were conducted in several South Bay tidal marshes by Harvey and Associates (Section D.5.k). Results were pending at the end of the year. Although little is known regarding the impact of red foxes on salt marsh harvest mice, foxes are now abundant in mouse habitat and have been seen foraging on rodents there. The draft Predator Management Plan and Environmental Assessment, if approved and implemented, would undoubtedly benefit this endangered species.

f. Aleutian Canada Goose

We continued to monitor the Aleutian Canada goose population that overwinters around the East Bay reservoir system, mostly through a volunteer effort. Numbers peaked at 56 in 1988-89 around the Nunes ranch stock pond, a continuation of the downward trend observed since 1984-85 when 140 were seen. Numbers rebounded in 1989-90, peaking at 110 on December 26. Birds arrived in mid-November, the earliest arrival ever recorded.

A concurrent monitoring program was conducted by environmental consultants, LSA. They were working for a developer interested in building a housing development near the Nunes site. Although they did not detect Aleutian goose use on the proposed development site, they did confirm the presence of Aleutians at the nearby San Pablo Reservoir for the first time. Controversy over the proposed development resulted in greatly increased interest in Aleutians. Surveys were conducted by at least 3 entities. We met with the East Bay Municipal Utilities District to encourage minimizing disturbance by researchers at the site.

3. Waterfowl

Intensive waterfowl surveys were conducted in 1988-89 and 1989-90 as part of a cooperative study with the Northern Prairie Field Research Station - Dixon. Aerial surveys were conducted over all of the open water of San Francisco Bay, as well as the salt ponds and other wetlands that fringe the Bay. Two surveys were conducted each month from October to April. Each survey took 12 hours of flight time over two days to complete. During the 1988-89 season, waterfowl numbers peaked at over 250,000 in January. Waterfowl numbers in 1989-90 peaked at over 284,000 in early December. Species in greatest abundance included scaup, scoter, shoveler, ruddy duck, canvasback and pintail, in

decreasing order of abundance. Surveys confirmed that most puddle ducks occurred in the salt ponds, but that large numbers of canvasback and ruddy duck also used the ponds. Scaup and scoter numbers peaked in late November and early December 1989. More detailed results of this study will be available in 1992 (Section D.5.C).

San Francisco Bay continues to be the most important wintering area for Pacific Flyway populations of canvasbacks. Bay-wide canvasback populations have averaged 18,446 during 1984-1989 midwinter inventories. Canvasbacks peaked at just under 30,000 in January 1990, 67% of the canvasbacks observed during the 1990 California midwinter inventory. Diving ducks and sea ducks dominated waterfowl populations in San Francisco Bay, making up 218,248 (85%) of the 258,133 ducks seen in San Francisco Bay in the midwinter survey. Canada geese are observed in relatively small numbers around the Bay. However, large flocks of Canada geese, numbering in the thousands, winter in the freshwater reservoirs in the foothills surrounding the Bay.

Table 1. Midwinter waterfowl inventory data for the Pacific Flyway, California, and San Francisco Bay. Numbers represent total ducks counted during aerial surveys in 1984 to 1990.

Year	San Francisco Bay*	California	Pacific Flyway	SFB/Calif Percentage**
1984	338,725	5,315,480	6,550,864	6.4%
1985	215,425	2,163,235	3,950,057	9.9%
1986	322,425	2,525,363	4,102,726	12.8%
1987	101,578	2,035,019,	3,602,035	5.0%
1988	161,619	3,264,666	4,917,977	5.0%
1989	186,097	2,002,119	3,358,430	9.3%
1990	258,133	2,609,953	4,456,431	9.9%
Average				
1984-90	220,980	2,884,314	4,413,682	7.7%

* Does not include population surveys from Suisun Marsh or the Delta.

** San Francisco Bay as a percentage of the total California population.

Table 2. Midwinter waterfowl inventory data for selected species in San Francisco Bay, 1984-1990.

<u>Species</u>	<u>1984-1989</u>	<u>1990</u>
	<u>Average</u>	
Scaup	73,761	122,709
Scoter	29,667	48,281
Ruddy duck	24,780	12,191
Canvasback	18,466	29,828
Bufflehead	3,907	4,280
Northern shoveler	28,280	30,930
American wigeon	14,912	1,658
Northern pintail	8,907	5,123
Gadwall	3,065	632

4. Marsh and Water Birds

The Refuge currently supports one active breeding colony of herons and egrets along Mallard Slough. A second colony on Bair Island is located on private land immediately adjacent to the Refuge. The Bair Island colony was established in 1967 when great blue herons first colonized the area. Two years later, black-crowned night-herons and snowy egrets initiated breeding activities on the island and the number of breeding pairs began to increase rapidly. The Mallard Slough colony was formed in 1976 when black-crowned night herons and snowy egrets began nesting at this site near the Environmental Education Center. At this site, nests are found in dense stands of hardstem bulrush which has become established in response to tremendous outflows of treated sewage effluent (120-150 million gallons per day) from the San Jose/Santa Clara Water Pollution Control Plant. In 1990, approximately 532 snowy egrets, 60 great egrets, 229 black-crowned night herons, 2 cattle egrets and 2 little blue herons were observed at the colony.

The Bair Island colony is situated on a dredge spoil site that supports a stand of coyote bush, thistles and annual grasses. Due to a combination of old age, lack of recruitment of new plants, and extensive use by nesting herons, the coyote bush stands are deteriorating. As a result, the herons and egrets have begun nesting on the ground and in the thistles where they are more susceptible to disturbance and predation. Several wooden nesting platforms were constructed and erected in 1986, however, the platforms have only been used for roosting. In 1989, the heronry consisted of 263 snowy egret nests, 207 black-crowned night heron nests, 5 great egret nests and 17 great blue heron nests. In 1990, numbers of nests were 174, 183, 9, and 18, respectively.

5. Shorebirds, Gulls, Terns and Allied Species

San Francisco Bay is one of the most important sites for shorebirds along the Pacific Coast south of Alaska. As many as 1,000,000 shorebirds may winter here or migrate through the area as evidenced by PRBO surveys (Section D.5.b). Numbers are highest in south San Francisco Bay. Western sandpipers are the most abundant species, followed by dunlins, dowitchers, least sandpipers, and marbled godwits. Shorebirds feed in the mudflats of the Bay during low tides. During high tides they may use seasonal wetlands, salt ponds, and other areas sheltered from tidal effects. More information is needed on shorebird habitat use.

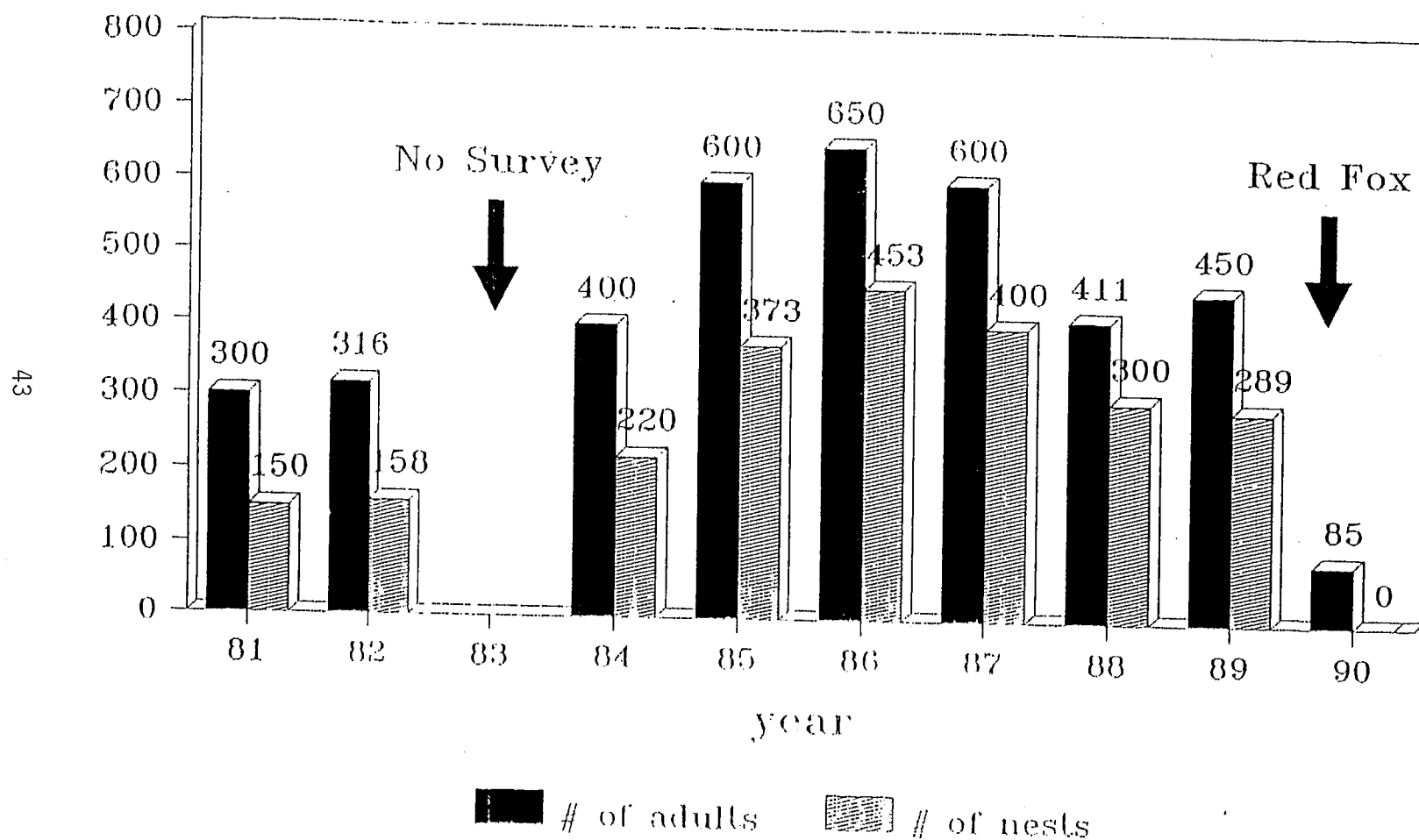
Snowy plover nesting was monitored in the Crescent Pond, an impounded area along the refuge entrance road that we drain each spring to provide nesting habitat. Eight nests were found, including five that hatched and three that were lost to mammalian predation.

Forster's and Caspian Terns have nested in south San Francisco Bay since 1948 and 1916, respectively. Prior to the conversion of a majority of the tidal marshes around the bay into salt evaporation ponds, suitable habitat for nesting was not available for these and several other species including American avocet, black-necked stilt, snowy plover and California gull. However, the isolated dikes and islands in the ponds have provided the open substrate and protection from predators that these species require.

In 1990, peak breeding counts of 2344 Forster's terns and 200 Caspian terns were observed, compared to less than 2600 Forster's and 1050 Caspian terns in 1989. This contrasts with previous totals of 5,000 Forster's and 2,400 Caspian terns censused in 1981. The significant declines observed in these tern populations are difficult to account for but may be related to a decrease in nesting habitat caused by dike maintenance and construction, marsh restoration or possibly relocation of birds to the Napa Marsh area.

In addition, the Refuge monitored the Caspian tern colony located south of Albrae Slough, in the East bay, along the M4-M5 salt pond levee. This colony has traditionally supported several hundred breeding pairs (see graph). In early May 1990, all nests were destroyed by the non-native red fox (also see Section G.15). More than 30 eggs were found cached (buried) in the levee near the colony. Although breeding terns attempted to reneest, all eggs were taken by red foxes and eventually the colony was abandoned. Two to three red foxes were regularly observed on the levee near the colony during nighttime spotlight surveys. This was one of just five Caspian tern colonies along the central and northern California coast.

CASPIAN TERN COLONY At Albrae Slough (1981-1990)



Levee between Ponds M4 and M5

Since 1981, California gulls have nested on islands in a salt pond acquired from The Nature Conservancy. In 1984 a second colony was discovered near the Leslie Salt Company plant in Newark and in 1985, a third colony appeared on the Knapp property on the Refuge at the south end of the Bay. The rapid establishment of this species in the South Bay is particularly interesting since it demonstrates a westward range extension and departure from their more typical Great Basin nesting habitat. Numbers continued to increase dramatically from the 30 pairs encountered in 1981. This year, 2221 nests were surveyed on the Knapp property compared to 2164 in 1989.

The Leslie Salt Company Plant site supported 0 nests and the Pond A9 levee supported 61 nests in 1990, a decrease from 217 nests in 1989. Because abundant invertebrates in the salt ponds and numerous landfill sites around the South Bay provide an unlimited food source for gulls, the availability of secure nest sites may ultimately limit this breeding population. Monitoring of the gull breeding population was continued jointly with the San Francisco Bay Bird Observatory.

6. Raptors

The Refuge provides breeding habitat for several species, including northern harriers, red-tailed hawks, short-eared owls, great horned owls, black shouldered kites, and burrowing owls. Several other species forage on the Refuge during winter months such as sharp-shinned hawks and Cooper's hawks. Golden eagles are occasionally seen in winter months.

9. Marine Mammals

An intensive three-year harbor seal study was initiated in 1989 by researchers from the Romberg-Tiburon Center for Environmental Studies (D.5.j). The project proposal was reviewed and authorized by the National Marine Fisheries Service and the U.S. Fish and Wildlife Service in 1989. Trapping began on the Refuge at Mowry Slough on August 2, 1989. Twenty-nine adult and juvenile harbor seals were captured. Each seal was individually weighed, measured, blood sample extracted, and flipper tagged. In addition, radio-transmitters were attached to the head of selected individuals. The transmitters were not binding and were attached in such a way that they fall off during the next molt.

In February of this year, 37 seals were captured at Mowry Slough over three days. Eighteen were radio tagged and 20 had blood samples taken. We turned down a request to conduct another capture in December at Mowry Slough. The capture site is also crucial habitat for the California clapper rail and researchers had scheduled the capture during extreme winter high tides, the

most vulnerable time for rails. Instead, they were allowed to conduct captures at Greco Island on 4-5 December. Two seals were captured and radio tagged.

Initial monitoring (in late 1989) indicated that movements of individuals varied greatly. Some seals stayed in the South Bay while others were resighted in the North Bay. One seal moved to Corte Madera Ecological Reserve in the North Bay and back to Mowry three times in one month. During the winter, the majority of seals were resighted at Yerba Buena Island in the North Bay, a focal point for the 1989-1990 herring run in San Francisco Bay. The majority of seals tagged in February, most notably pregnant females, showed a high degree of site fidelity.

In 1989, spring seal counts at Mowry Slough and Greco Island (both Refuge marshes) peaked at 306, 17% lower than the 365 observed in 1976. In 1990, numbers at Mowry rose to 366 (numbers at Greco were not obtained). The 1990 bay-wide count was 566 with a continued shift in seal numbers to the North Bay.

In 1976, a total maximum pup count of 100 produced a bay-wide reproductive rate of 29% (number of pups/number of adults and juveniles). In 1990, 107 pups produced a reproductive rate of 19%. The reproductive rate at Mowry Slough dropped from 40% in 1976 to 29% in 1990.

Conclusions regarding pollutant levels and the health of San Francisco Bay harbor seals will be reported in future narratives, as results become available.

15. Animal Control

We documented strong evidence of the direct impacts of the non-native red fox on California clapper rails in 1989 and 1990 (Section G.2.d). Predator management planning was accordingly begun in 1990. We attended a meeting in January to discuss non-native red fox impacts and discuss solutions with the Santa Clara Valley Audubon Society, Golden Gate Audubon Society, Save San Francisco Bay, San Francisco Bay Bird Observatory, Sacramento Enhancement (FWS), California Department of Fish and Game, and East Bay Regional Park District. In June, we mailed letters to 150 addresses announcing the intention to develop a predator management plan and environmental assessment and solicit any comments.

A draft assessment was sent out in July to approximately 200 addresses. The draft plan described an integrated management effort that would include the use of barriers where possible, trapping using padded leghold traps, and shooting. Trapped animals would be killed on the site using shooting or injection. Management effort would be directed at red foxes, feral cats, Norway rats, racoons, and skunks. Species were selected based on

results of our studies on rails and the predators impacting rails (nests and/or adults). Work would be focused in areas crucial to California clapper rails, with some work conducted at colonial nesting bird colonies (e.g., Caspian terns).

Thirty-six comments were received. The majority supported the management plan, but several voiced strong opposition, particularly to any lethal removal of red foxes. Suggestions were made for improving the quality and accuracy of the draft assessment. Two meetings were held with Dr. John Grandy from the Humane Society of the United States in August and October. He represented other groups as well, including the Humane Society of Santa Clara Valley, Ohlone Humane Society, and Peninsula Humane Society. Refuge staff also met with the Leslie Salt Company in November 1990 to discuss predator management concerns and potential effects on salt making operations. All comments received were fully evaluated with the expectation that a final environmental assessment and predator management plan would be completed in early 1991.

16. Marking and Banding

This year marked the seventh year of color-banding young chicks from the major south bay California gull colony. Approximately 500 gull chicks were banded with USFWS bands by volunteers with the San Francisco Bay Bird Observatory.

17. Disease Prevention and Control

Botulism outbreaks have been recorded in the South Bay in the past. The outbreaks have been aggravated by the discharge of sewage effluent (over 120 million gallons per day) into Mallard Slough and Coyote Creek. The area is monitored by members of the San Francisco Bay Bird Observatory under contract with the local dischargers. Fortunately, in 1990, botulism was not a problem; few dead birds were found.

H. PUBLIC USE

1. General

San Francisco Bay National Wildlife Refuge serves a dense, local population of more than seven million people. It is an ideal place for Bay Area urbanites to visit a relatively unspoiled area, enjoy the local wildlife and learn about nature, conservation and wildlife management. During 1990, almost 300,000 people visited the Refuge. Of these, 11,193 students and 2,622 teachers attended classroom activities at the Environmental Education Center in Alviso and the Visitor Center in Fremont. Thirty-seven thousand people stopped in at the Visitor Center and 4,000 attended interpretive programs. Many more visitors received our self-guided interpretive messages when they read our wayside exhibits.

Refuge personnel and volunteers conducted summer day camps at both centers. A total of 188 children participated.

Two thirds of our 1990 visitors participated in recreational activities other than formal programs at one of the centers. The public fishing area, trails and sloughs were used by visitors. Many of these people were contacted in the field by Refuge volunteers on patrol.

General public use is limited at the Environmental Education Center (EEC). The EEC is only open Monday through Friday between 8:00am and 4:30pm due to staffing constraints. The number of drop-in visitors that were counted totaled 3,907. A total of 15 special use groups utilized the EEC.

2. Outdoor Classrooms - Students

During 1990, the Environmental Education Program at both sites devoted the first three weeks of September to curriculum development and equipment and educational props inventory and replacement. Demand for school group use during this time is limited. Fall reservations from August 1st and spring reservations are taken from December 1st on. With this type of booking schedule, we had minimal field trip cancellations.

Field trips involve students in indoor and outdoor activities revolving around a central theme chosen by the teacher for the field trip. Audio visual material, including film and slide shows, are provided. A ratio of 10 students to one or two adults (one acts as an activity leader) is strongly encouraged to provide an enhanced learning experience for the students while at the Refuge.

With a small staff at both sites, many of the demands for our programs would go unfilled without the aid of Student Conservation Association interns (SCA) and several dedicated volunteers. The volunteers and SCAs learn the basics of the EEC program and then either lead particular activities, present opening and closing programs and/or provide support to teachers/parent leaders during their activities. When not busy with visiting school groups, SCAs and volunteers help the staff with special projects which enhance the educational experience for visitors and students. Lee Lovelady, a volunteer at the EEC for six years, continues to lead owl pellet dissection classes two times per week for student field trips and conducts pre-trip visits to the classrooms of at least a fourth of our field study students.

a. Environmental Education-Environmental Education Center, Alviso

The Environmental Education Center (EEC) was used extensively again this year. Primary use was school field trips, however other groups such as scouts also used the facility. By the middle of January 1990, all available dates for 1990 spring field trips had been booked. The Center was visited by 5798 students and 1599 teachers and parent leaders on the all day field trips. The total visitor and field trip usage for 1990 was 12,304. For two months of 1990, the Center operated short handed before Jackie Burns came on as permanent staff. Also, in the summer we were short staffed with no intern for three months.

Again this year, as in previous years, there was more demand for our program than we were able to meet. To help alleviate this problem, we double-booked field trips when fully staffed. We were able to do this in the beginning of spring and the fall of 1990. The second school that booked a field trip for the same day had access to equipment, use of the Center's habitats, and a patio with picnic tables to use as their brine shrimp laboratory. The Center is unique in that the facility is designed to incorporate both laboratory and outside settings for use during field trips.

The "Marsh-In" day camp was offered for the 9th consecutive year attended by 25 4th, 5th, 6th graders and junior high leaders. Due to a new staff person and no summer intern, only one session was offered this summer with a larger enrollment for that session. One overnigher at the EEC was included in each session. The program is primarily designed to reach children from the nearby community of Alviso. By involving these children in the EEC and the Refuge, we have been successful in gaining acceptance by the local community. Through the day camp, local children gain an understanding and respect for wildlife and the Refuge itself. The fourth year of the five day program with an overnight was a huge success. The camp sessions are taught by

seven local professional volunteer naturalists, many of whom have helped since "Marsh-In's" began. The EEC staff conducts training sessions for the volunteers to introduce new activities used during the camp. As in other years, this year's camp was on Native Americans.



Marsh-In campers and junior leaders make clam shell beads with volunteer leader Rachel Santos.

b. Environmental Education Program - Visitor Center, Fremont

This was the third year the Refuge Visitor Center Environmental Education Program in Fremont offered teacher-led field trips the entire school year. The program served 5486 students and 1024 teachers and parent leaders on all day field trips (including YMCA and scout groups). These teacher-led field trips are designed after the EEC model with the exception that more of the activities are conducted outdoors. Openings and closings are held in the Visitor Center auditorium. An old pump house building has been converted into a lab classroom, and is also used as a gathering and equipment distribution point. The pumphouse is also used by California State University, Hayward, field biology and ecology classes to conduct studies on the salt marsh.

The Visitor Center environmental education staff offers a summer day camp called "Junior Naturalists." This year two camp sessions were held. Each were one week long (Monday-Friday, 10:00am - 2:00pm each day). The first week was for kids entering the 3rd and 4th grades and the second week was for kids entering the 5th and 6th grades. Twenty students participated in each session. A total of six adult volunteer leaders and six youth volunteer leaders ran the different sessions. The program combined elements of environmental education, natural science instruction, and experiential education. Each day's program included group dynamics exercises, nature study, ecological concepts, physical activity and conservation activities. The schedule was organized around habitats and each day habitats were visited.



Junior Naturalists check to see if they have captured sufficient brine shrimp from the salt pond to take for further observation and study.

The Visitor Center was the site of a Girl Scout Camp held in August. One hundred girls and 30 adult leaders participated in the week's activities, led by Girl Scout leaders who had attended a Teacher Orientation Workshop offered at the Visitor Center. The girls made "bughouses" (wood-and-screen boxes for holding and observing insects), pressed-flower stationery, and other nature craft items. They practiced tying knots and using compasses. They examined brine shrimp and owl pellets, watched nature videos, and went on hikes. The week was active and, apparently, successful - the group has made plans to return in 1990.



A young student absorbed in her task, works hard during a school field trip.

New facilities were either added or conceived and planned during 1990. We built an amphitheater near our "Pumphouse" environmental education station. With a seating capacity of 35 in a shady grove, it nicely supplements our carrying capacity.

At years' end, we were preparing to construct a large, covered, environmental education pavilion nearby. Leslie Salt Company donated \$5,000.00 to help with construction costs.

3. Outdoor Class Rooms - Teachers

In the San Francisco Bay area, where many environmental education facilities and programs are available for teachers to choose from, the Refuge EE program is unique from all others. By making teachers fully responsible and highly involved in their field trip, they are more likely to integrate the classroom curriculum with their field trip. As a result, students achieve a more meaningful, in-depth experience.

We provide a facility where teachers can lead their own field trips following the training and guidance we provide. Teachers plan their field trips, prepare their students and conduct the field trips following the individual formats designed by them.

This format provides teachers and students with a learning environment which often extends into the classroom beyond the day spent on the Refuge. The EE staff, SCAs and volunteers offer training and support both before and during the field trip. By having teachers prepare their field activities and recruit parents to help conduct them, the EE program can effectively reach more students with individual attention than had the staff conducted the field trips by themselves. A high adult/student ratio (one or two adults to every 10 students) is important to enhance the learning experience.

Before a field trip to the Refuge can be scheduled, at least one adult must attend a three and a half to five hour Teacher Orientation Workshop. The staff is available for individual planning sessions should teachers require assistance in planning their trips. One evening a month is reserved for teachers planning sessions at the EEC, in Alviso. A total of 12 teacher orientation workshops were offered at the EEC with 284 individuals participating, plus 43 teachers who returned for one hour planning sessions. Nine teacher orientation workshops were held at the Visitor Center in Fremont with 225 teacher/leaders being trained. The confidence gained by the teacher and adult helpers at these orientation workshops is invaluable to a successful field trip.

Throughout 1990, the Refuge environmental education staff was proud to continue distribution of the Salt Marsh Manual - an Educator's Guide. The 180 page guide was designed to facilitate the discovery, learning and enjoyment of field trips to the San Francisco Bay National Wildlife Refuge. The guide contains background information, area maps, planning and group management hints, classroom and on-site activities and additional resource information. The activities in the guide are for grades K-8.

The guide is free of charge to all teachers and group leaders who attend one of the Teacher Orientation Workshops at either the Environmental Education Center in Alviso or the Visitor Center in Fremont. Individuals not attending the orientation can obtain a copy for \$6.00.

The EEC staff was actively involved throughout 1990 with Project WILD and Project Learning Tree which offer their curriculum guides only through workshops. These are co-sponsored with Coyote Point Museum, an environmental education center in San Mateo County. Project WILD is an interdisciplinary wildlife education program that uses wildlife related instructional activities for grades K-12 whose overall purpose is to conserve wildlife and natural resources. Two Project WILD workshops, one Project Learning Tree, and a two-day Land and Sea workshop were offered with 112 participants. One of these workshops was conducted with the new Aquatic project WILD guide. This guide focuses on Aquatic-related habitats and is a resource for teachers to use when teaching about the San Francisco Bay ecosystem. In March, a Project WILD workshop was conducted at the Northern California Math/Science conference. In February, a Teacher Open House was offered to teachers to give them curriculum ideas for celebrating April's Earth Week in their classrooms. This Earth Day open house was co-sponsored at the EEC with a local environmental education program run by the city of Mountain View's Deer Hollow Farm. Every teacher in the city of Mountain View received a copy of the Earth Day curriculum guide developed by the staffs of the EEC and Deer Hollow Farm. We were the first environmental education organizations in northern California to produce an Earth Week guide for teachers. We received many calls throughout the state for copies of this guide. The 45 teachers who attended the open house received a copy of the curriculum guide. The remaining guides were sent to teachers on request.

See the addendum at the back of this narrative for a copy of the Earth Week curriculum guide.



Teachers discuss field trip activities during a break at a teacher orientation.

4. Interpretive Foot Trails

The Refuge has two trails with interpretive wayside exhibits. These displays describe the habitat, the cultural history, the ecological dynamics and geology of the areas that visitors walk through. They are entertaining, easy to read, visible without being intrusive and serve as an important supplement to our interpretive effort.

The self-guided trails are especially important during hours when the Visitor Center is closed. From 5:00pm to sunset, and before 10:00am, trail use is often heavy.

The Tidelands Trail is registered as a National Recreation Trail in the National Trails System.

6. Interpretive Exhibits and Demonstrations

During 1990, 152,000 visitors participated in interpretive activities at the Refuge. Almost 147,000 took advantage of our self-guided interpretive trail or visited the interpretive center to watch films and look at the educational displays. The remaining 5,000 participated in the numerous naturalist-conducted programs such as walks, van tours, talks, slide presentations, and bicycle and canoe trips. The natural history of the Refuge was well represented in our 1990 programs with topics such as salt marsh ecology, insects, birds, seasonal wetlands, endangered species, edible plants, geology and mammals.

Our program audiences were as diverse as the program topics that we presented. Audubon chapters, day care centers, garden clubs, hospitals, scout troops, community groups, senior centers, teachers' associations and women's organizations, among many others, took advantage of the available programs. The greatest demand for naturalist-led activities, however, came from families who discovered the wildlife resources of the Refuge and the Bay Area.

Among the most popular activities were the tours of Drawbridge, an abandoned sportsmen's community in a salt marsh setting. The dilapidated town stands as a reminder of the consequences of human destruction of the native environment. This was the theme as 350 people visited the area during tours offered on Saturdays from May through October.

We also conducted nature walks, talks, slide shows and other interpretive programs for the public on Saturdays and Sundays throughout the year.

Our volunteers were quite active in giving public tours on the weekends during 1990. They covered such topics as geology, salt marsh ecology, birds and astronomy.



Nature photographers work at improving their photography skills during our monthly "Focus on Nature" program led by a volunteer photographer.



Kayakers and canoers paddle down the Newark Slough on a monthly "Canoe the Slough" program led by a volunteer naturalist and canoer.

Many special events were also held at the Refuge during 1990, all with good success. In November of 1989, the Public Use staff organized a planning session for Bay Area refuges, parks and other local nature centers, to create an Earth Day that would be noteworthy and memorable. Successive planning sessions were also held, and on April 22, 1990, Earth Day went off without a hitch.

There were two parts to the celebration. First, "Bike About the Bay" brought thousands of bicyclists through the Refuge on their way from one end of a 35-mile course to the other. On their way, they stopped at the San Leandro Marina, Hayward Shoreline Visitor Center, Coyote Hills Regional Park, our check-in booth at the Refuge, Palo Alto Baylands and Shoreline at Mountain View.

The intention of this mass-migration was to demonstrate our ability to use non-polluting means of transportation. We believe that we made an important, symbolic statement. It also gave good exposure to our Refuge, as crowds of bicyclists stopped here for refreshments (donated by local corporations) or to get their "passports" stamped (a passport is located at the back of this narrative).

To make it easier for bicyclists to ride the entire length of the course, we organized a shuttle service with which we transported 50 bicycles and their riders from one end of the course to the other. The shuttle ran back and forth all day.

It was a large event to organize, considering the number of communities that hosted parts of the event. Funding for printing the passports came from the San Francisco Estuary Project.

The second part of the Earth Day celebration was an open house in the Visitor Center. Guest speakers entertained and educated audiences with programs on extinction, local wildlife, Indian lore, endangered species, and environmental issues. We also presented the awards for our annual Endangered Species Poster Contest to local school kids.

In addition, our environmental education staff conducted an open house for teachers, and presented them with an "Earth Week Curriculum Packet." See Section H.2 for more information.



Assisted by volunteers, kids make their own recycled paper at our "Earthday at the Refuge" celebration.



Our popular Native Plants Sale was twice as big as last year and drew drought resistant and native plant lovers from all over the Bay to the Refuge.



Our annual "Kids Day" is great fun every year for kids of all ages.



Pumpkin decorators turned out in force during our annual Halloween Open House.



Everyday something is going on in our Visitor Center. Many programs and demonstrations are conceived, written, rehearsed and presented by volunteers.

7. Other Interpretive Programs

The Refuge participated in some non-traditional forms of interpretation. Foremost among these was the production and distribution of a quarterly newsletter, Tideline. A copy of each issue of the newsletter is included at the back of this narrative. Tideline was distributed to nearly 28,000 Bay area households, schools, businesses, churches, hospitals and libraries. It was considered to be our very best means of communicating our program schedules, announcements, news stories, advertisements and editorial comments. In fact, many of our programs were filled to capacity by Tideline recipients. The Tideline was used as a text at a training course for urban managers at the National Park Service's Training Center at Harper's Ferry in West Virginia. It was also used as a supplement to formal text books in many high school biology classes. We repeatedly get requests from biology teachers for subscriptions for that purpose.

Tideline was produced and edited by Volunteer Janis Tipton-King, who also serves as a director of our cooperating association (see Section H.18). Our mailing list was managed by Volunteer Howard Collins, who coordinated additions to the list, deletions and address changes. Without volunteer assistance, Tideline would not be possible.



It's all hands on deck for staff and volunteers alike during the final stages of the quarterly mailing of Tideline.



Another non-traditional interpretative effort was the Refuge's ninth Spring Poster Contest, which attracted 2000 entries by artists in grades K-6 from the three local school districts. The contest theme this year was "Endangered Species."

First place winners in each grade won free passes for themselves and their parents to the Marine World/Africa USA. Second place winners and their parents won a trip to the San Francisco Zoo. Third place winners each won a pass for three to California Academy of Sciences in San Francisco's Golden Gate Park. All winners and honorable mentions received ribbons.

We feel that a poster contest is a good way to reach members of the public who might otherwise never make it to the Refuge. These students spent hours (days) preparing posters which advocated the preservation of San Francisco Bay and its wildlife. In the process, each artist may have convinced him/herself that a conservation endeavor is a worthwhile pursuit. This is difficult to measure, but, considering the persuasive, convincing nature of most of the posters, we feel that many advocates of our conservation ethic were either created or reinforced.

In addition, the awareness level of many South Bay students (as well as teachers and parents!) was heightened and many visitors checking in at the reception desk stated that their curiosity had been piqued by the contest, and that they were here to see who we were and what we were all about.

In spite of all of the efforts that we made during the year to contact the public, we know that there are many thousands of people out there whose interests do not include endangered species, wetland preservation, migration, waterfowl populations or anything else along those lines. Reaching these people is one of the most challenging tasks with which the interpretive staff is confronted. And the first step in reaching them is getting them out to the Refuge where they can see with their own eyes what sort of job we are doing.



During one of his interpretive programs, volunteer naturalist, Mansur Nurmuhammad, answers the questions of a young visitor.

In 1990, the EEC continued its Lending Audio Visual Library. The library began with a 13 minute VHS video tape named, "Who Did The Owl Eat?" This tape with accompanying charts is checked out by teachers to use in their classrooms. It depicts a barn owl's hunting and eating habits, regurgitation of an owl pellet and directions on how to dissect a pellet. Appropriate grade levels are first through sixth. Teachers are encouraged to copy the tape and many of the charts to have in their school curriculum library for future use. Other refuges have copied the tape to lend out to teachers.

Santa Clara Girl Scout Calendars

See the addendum at the back of this narrative for a copy of the Girl Scouts of Santa Clara County calendars. The salt marsh of the EEC with girl scouts walking on the boardwalk at sunset was chosen for the covers of both calendars and featured in the March Section of the large calendar.

San Francisco Estuary Curriculum Project

Because of growing public concern for health of San Francisco Bay and the Sacramento/San Joaquin Delta Estuary, the U.S. Environmental Protection Agency established the San Francisco Estuary Project, a cooperative local, state and federal program. The SFEP is charged with developing and promoting effective management of the estuary, including restoring and maintaining its water quality and natural resources.

In May 1989, the San Francisco Estuary Project contracted the Save San Francisco Bay Association to develop full public education and an involvement plan for intensified public outreach to develop support for restoration of the estuary as outlined in the SFEP's 1989 Scope of Work for the Public Involvement Program. The four major target audiences include children, SFEP constituent groups, the general public, and local, state and federal decision makers.

Since children represent the future, the Estuary Project can help build a life-long ethic in the generations to follow, the users and the decision-makers by focusing on education programs and activities at public and private schools. To accomplish this task, the San Francisco Estuary Curriculum Project was formed. The San Francisco Bay National Wildlife Refuge is one of the environmental organizations that is acting as an advisor to agree on estuary curriculum that could augment and expand current bay/marine science education taught in Bay-Delta schools. The advisory group is reviewing available environmental/bay curriculum such as our Salt Marsh Manual, and if necessary, developing new curriculum components.

Spanish Program for residents of Alviso at the EEC

In July, an evening program was conducted in Spanish for the residents of Alviso, a Mexican/American community. Twenty-five residents attended a slide show about San Francisco Bay and went on a nature walk through New Chicago Marsh.

MEEA - Recycling Partnership for Schools and Businesses Project

The Recycling Partnership for Schools and Businesses is a project of the Mid-Peninsula Environmental Education Alliance (MEEA) and the Santa Clara County Manufacturing Group Environmental Committee (SCCMG). MEEA is a group of non-profit organizations working together to bring different aspects of environmental education to our communities. The San Francisco Bay National Wildlife Refuge is a member of MEEA represented by their Environmental Education staff. Fran McTamane, EEC Coordinator, is a member of the advisory committee for this project.

In late 1989, MEEA was approached by members of the SCCMG, who were interested in developing a community-wide environmental education project. This program would include members of the business community and needed to be easily adapted to different levels of involvement.

Brainstorming among representatives from MEEA affiliates and members of SCCMG resulted in a project which combines the resources of businesses with the future of our community--kids. This program employs recycling as a catalyst for building school-business partnerships based on the Adopt-a-School concept. Initially, it will target middle-schools: the goal is to help each school and its business partner incorporate the 3R's of recycling -- reduce, reuse, recycle -- into its daily operations.

As part of the program, an outline for the guidebook was developed, based on what the program should accomplish -- including allowing enough flexibility for each partnership to individualize its program in response to its particular situation. The Project Director will work closely with the program's advisors to determine which schools and businesses will participate. Once the program has been successfully piloted and expanded, individual businesses and schools, aided by the comprehensive guidebook, will be able to set up and manage their own recycling partnerships.

The program, and the accompanying guidebook, will contain the following components: Overview and goals of the program; Team development; Reduce, recycle, reuse: how it will be done, who is going to do it, reward systems; Evaluations; Additional resources -- suggested activities and curricula.

8. Hunting

The walk-in hunting area at Ravenswood reopened to hunting this year. Approximately 1,500-2,000 hunters used the Ravenswood unit this year with a very low take ratio.

Another 1,500-2,000 hunters utilized the remaining open areas. These areas are opened to boat access only.

Shoveler, scaup and green-winged teal made up the majority of the bag, however, the availability of birds this year was low due to duck numbers and Bay area weather. In fact, most of this year's waterfowl season was worked by L.E. Officers wearing Class B/C short sleeve uniforms.

9. Fishing

Public use of the access along the Dumbarton Point Trail (south end of the fishing pier) and the Shoreline Trail (north of the fishing pier) continued to increase. Use of the Dumbarton and

Ravenswood Fishing Piers stayed about the same as last year. Approximately 25,000 anglers used the piers and the surrounding fishing areas in 1990.

Fishing from or near the piers has netted a variety of fish: leopard shark, sand shark, bat ray, shiner surf perch, kingfish, bullhead, and the elusive striped bass, white sturgeon and salmon.

Fishing at the Coyote Creek Lagoon has netted stripped bass, white sturgeon and salmon.

11. Wildlife Observation

The opportunity to view wildlife in its natural habitat attracts many of our visitors. In close proximity to the Visitor Center is salt marsh, slough, extensive mud flats, open water and upland coastal chaparral, grassland and trees. This range of habitats provides an ideal area for visitors to explore, alone or with our naturalists, when seeking local wildlife.

Some visitors participated in hikes, van tours or canoe trips to Mallard Slough and Triangle Marsh, where marsh-nesting and feeding birds were easily seen. Others were led by a naturalist to Dumbarton Marsh, where the endangered California clapper rail nests. Only when the salt marsh is flooded by a very high tide do these nearly flightless birds emerge from the protective vegetation. Bird watchers revel in these opportunities.

In addition, many nature study groups led field trips to our refuge, and the Audubon Society once again conducted its annual Christmas bird count here. One of the most popular sites for local bird watchers was the restored tidal area, Avocet Marsh, where great numbers of shorebirds and migratory waterfowl gather to feed. There is also a peregrine falcon commonly sighted here.

On July 1st, the Refuge participated in the 14th Annual 4th of July Butterfly Count conducted by the Xerces Society. The event was announced in Tideline and drew a number of seasoned, professional lepidopterists as well as first-time amateurs. We spent the day searching out butterflies near the Visitor Center and EEC, as well as a nearby riparian corridor, and amassed a total of 23 species. It was great fun for everyone and will be repeated in 1991.

17. Law Enforcement

The goals of our public safety unit continues to remain the same: crime deterrence as a short-range goal and crime prevention as the long range goal. As our visitation increases at San Francisco Bay NWR and eventually at several of the satellites both of these goals will remain a challenge.

Patrolling is done selectively depending on previous incidents and the number of visitors using the area. Patrol activities in the North Bay were conducted by an assistant refuge manager with law enforcement authority. These patrols were limited mainly to weekdays while conducting other duties in the area. Random weekend patrols were conducted by the police officers.

A total of 34 permits were issued for controlled activities within 6 of the refuges in the Complex. Permits were issued for gathering biological data, Christmas bird counts, and access for construction activities and various media activities.

On June 16th, a truck drove through our main gate which happened to be closed at the time (midnight). The driver went on to the shore, about 3 miles and after looking around for awhile, drove back out. Of course, the out bound side of the gate was still closed. He managed to destroy both parts of the gate. His truck died about a mile down the road so he walked home. The next morning, Officer Barry Tarbet found the gate and vehicle. Investigation lead him to the suspect's address. Officer Tarbet and a Hayward Police Department officer contacted the owner who told them the truck was parked out front. He said he had parked it there between 9:00-10:00pm that night. Unfortunately, his wife told the officers that he had not been home at 11:00pm and she did not know when he got home. They had met here as they were leaving. Confronted with this, he confessed all.



This truck not only broke through the Refuge entrance gate, it demolished the exit gate on the way out.

Vandalism incidents decreased by 50% compared to 1989. Interpretive signs on the fishing piers and Tidelands trails were vandalized as were gates, fences and boundary signs. We estimate that our replacement costs were approximately \$1,000.00 and labor cost associated with repairs and replacement was \$750.00. In order to provide a response and coverage after hours, a call out list has been established for the four officers. Each officer covers a three month period. The list is provided to the security alarm service, local police and fire departments, U.S. Coast Guard and the U.S. Park Police.

Refuge officers contacted approximately 15,000 individuals and were involved in 218 incidents during 1990. An incident is an event that occurs on Service lands or is personally encountered by Service enforcement personnel during the course of official duty. Incidents in which the staff were involved are listed in the following tables.

Table 1

Uniform Crime Incidents - 1990

Inv. 17-01-	<u>Class.</u>	<u>Number</u>	<u>Arrest</u>	<u>Warrant Arrests</u>
06 Burglary		1		
07 Larceny		3		
08 Motor Vehicle Theft		1	1	
14 Stolen Property		1		
15 Vandalism		8		
16 Weapons		1		
19 Narcotics Drug Laws		13	5	
22 Driving Under Influence	2			
23 Liquor Laws		1		1
27 Suspicion		2		
<hr/>				
Total	2	31	6	1

Table 2

Uniform Crime Incident - Five Year Comparison

<u>17-01---Class</u>	<u>1990</u> <u>No./Ast.*</u>		<u>1989</u> <u>No./Ast.</u>		<u>1988</u> <u>No./Ast.</u>		<u>1987</u> <u>No./Ast.</u>		<u>1986</u> <u>No./Ast.</u>	
01 Murder			1						1	
04 Robbery			1							
05 Aggravated Assault					1		2	1	1	1
06 Burglary	1		4				1		11	
07 Larceny	3		3	1	1		2			
08 Motor Vehicle Theft	1	1	1				2	2		
09 Simple Assault					1		1	1	1	
10 Arson					1					
11 Counterfeiting			1							
14 Stolen Property	1		3	2					7	
15 Vandalism	8		16		7		18		26	
16 Weapons (not inc. CFR)	1		7	2			17	6	9	2
19 Narcotic Drug Laws	13	5	58	50	30	31	2	2	5	4
22 Driving Under Influence			2				2	2	3	3
23 Liquor Laws	1		8							
25 Disorderly Conduct			2				2	2	2	
26 Vagrancy										
27 Suspicion	2		3		2				6	2
28 Curfew-Loitering										
29 Runaway			1	1			2	2		
Totals	31	6	111	56	43	31	57	20	66	10

Table 3
FWS Incidents - 1990

<u>INV 5-01-Classification</u>	<u>Number</u>
01 Person-Injured/Ill	3
08 Accident-Traffic	1
09 Accident-Boat	1
11 Animal Trespass	2
16 Assistance to Citizens	10
17 Assistance to other Organizations	*31
18 Unsecure Installation	18
Totals:	66

*Includes 10 warrant arrests totalling \$34,530 and assisting with communications at a murder scene/hostage situation. Two stolen vehicles were recovered with a total value of about \$16,000.

Table 4

FWS Incident - 5 Year Comparison

<u>05-01-Classification</u>	<u>1990</u>	<u>1989</u>	<u>1988</u>	<u>1987</u>	<u>1986</u>
01 Injured/Ill	3	1	1	2	13
02 Person Lost					
04 Possible Drowning				2	2
06 Suicide				1	1
07 Property Fund			4	3	3
08 Abandoned Property	1		2	6	
09 Fire-Property	1			3	1
10 Fire Habitat					2
11 Accident Traffic	2	1	4	7	9
13 Accident-Other Vehicles				2	
14 Animal Trespass		2	2	20	
16 Assistance to Citizen	10	6	35	13	22
17 Assistance to Organization	31	22	25	25	37
18 Unsecure Installation	18	17	16	18	12
19 Hazardous Area				5	3
20 Wildlife Carcass				2	
Totals	66	49	89	109	105

Table 5
Federal Violations - 1990

<u>Violation/Section</u>	<u>Guilty</u>	<u>Dismissed</u>	<u>Pending</u>	<u>Total</u>
Take Migratory Birds - MBTA	1	0	0	1
16 USC 703				
Duck Stamp	4	0	4	8
16 USC 718				
Unplugged Shotgun	2	0	0	2
50 CFR 20.21b				
Lead Shot	2	0	0	2
50 CFR 20.21j				
Take After Hours	2	0	0	2
50 CFR 20.23				
Violation of State Law	1	0	0	1
50 CFR 20.72				
Trespass	46	3	7	56
50 CFR 26.21a				
Trespass (Dog)	1	0	0	1
50 CFR 26.21b				
State Law (Vehicle)	2	0	0	2
50 CFR 27.31a				
Speeding	38	0	2	40
50 CFR 27.31d				
Drive Without License	1	0	0	1
50 CFR 27.31g				
Block Roadway/Gate	2	0	1	3
50 CFR 27.31h				
Possession of Firearms	4	0	1	5
50 CFR 27.41				
Damage Plants	1	0	0	1
50 CFR 27.51				
Waste Disposal	1	0	0	1
50 CFR 27.94				
TOTAL	108	3	15	126

The number of hunting violations cited increased from 37 in 1989 to 38 in 1990. Trespass citations decreased by 54, and traffic related citations fell by 73.

The above information shows only written citations. Verbal warnings are given out on a higher frequency than the written citations. The written citations are just the tip of the iceberg.

The bail schedule is still under revision. It is still being "fine tuned." As of this date, no updated bail schedule is available.

Table 6
State Violations - 1990

<u>Violation/Section</u>	<u>Guilty</u>	<u>Pend.</u>	<u>Dism.</u>	<u>Total</u>	<u>Warrants</u>
Hunting/Fishing w/o License	11	22	0	33	14
T14-700/F&G 7145					
Too Many Fishing Lines F&G 2.05	0	6	0	10	4
T14-28.65a (bay)					
No Landing Net In Boat (SF Bay)	0	1	0	1	1
T14-28.65c					
Take Dungeness Crab	0	3	0	3	1
T14-29.85					
No State Duck Stamp	0	1	0	0	1
T14-510					
Unplugged Shotgun	0	1	0	0	1
T14-507					
Overlimit Ducks	0	1	0	1	0
T14-502					
Use Another's License	1	0	0	1	0
F&G 1052					
Unlawful Take	0	1	0	1	0
F&G 2000					
Unlawful Possession	0	1	0	1	1
F&G 2002					
Show License/Game Devices on Demand	0	2	0	2	1
F&G 2012					
Hunter Trespass	1	1	0	2	1
F&G 2016					
Take Protected Bird	0	1	0	1	0
F&G 3511					
Take Non-Game Bird	1	0	0	1	0
F&G 3800					

Table 6 (continued)
State Violations - 1990

<u>Violation/Section</u>	<u>Guilty</u>	<u>Pend.</u>	<u>Dism.</u>	<u>Total</u>	<u>Warrants</u>
Littering within 150' of Water	1	1	0	2	1
F&G 5652					
Business & Prof. Code	1	3	0	4	3
Possession of					
Hyperdemic Needle	1	3	0	4	3
4149 B&P					
Minimum Poss. of Alcohol	2	3	0	5	0
25662 B&P					
Provide Alcohol to Minor	0	2	0	2	1
25658 B&P					
Narcotics Violations	12	22	1	35	13
CA Penal Code	8	10	0	18	4
CA Vehicle Code	132	323	31	489	14
TOTALS	174	405	35	614	91

- 1 Warrant Arrest
- 14 Dismiss on proof of compliance
- 13 Dismissed by plea bargain
- 2 Dismissed while in jail for other charges
- Traffic enforcement resulted in 13 warrant arrests

Table 6 (continued)
State Violations - 1990

<u>Violation/Section</u>	<u>Guilty</u>	<u>Pend.</u>	<u>Dism.</u>	<u>Total</u>	<u>Warrants</u>
Littering within 150' of Water	1	1	0	2	1
F&G 5652					
Business & Prof. Code	1	3	0	4	3
Possession of Hyperdemic Needle	1	3	0	4	3
4149 B&P					
Minimum Poss. of Alcohol	2	3	0	5	0
25662 B&P					
Provide Alcohol to Minor	0	2	0	2	1
25658 B&P					
Narcotics Violations	12	22	1	35	13
CA Penal Code	8	10	0	18	4
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- 1 Warrant Arrest
- 14 Dismiss on proof of compliance
- 13 Dismissed by plea bargain
- 2 Dismissed while in jail for other charges
- Traffic enforcement resulted in 13 warrant arrests

Citations were written for a total of 56 Fish and Game violations in 1990. The Fish and Game citations resulted in \$1459.00 in fines, two suspended sentences, 25 days in jail, 25 days of community service and \$10,188.00 in warrants outstanding. Narcotics violations resulted in \$919.00 in fines, 9 1/2 years probation/diversion and 113 days in jail. There are \$32,000.00

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The sharp decline in the total number of narcotics violations from 110 in 1989 to 37 in 1990 can be attributed to the heavy emphasis on narcotics enforcement in 1988 and 1989. It appears that via word of mouth from users and dealers, this refuge is not the place to hang out and do drugs. That along with our high conviction rate has resulted in the sharp decline in the number of narcotics related incidents.

18. Cooperating Associations

Nineteen-ninety was the third full year of operations for the San Francisco Bay Wildlife Society. This non-profit corporation has two objectives: to raise money, and then to spend it on environmental education projects at the Refuge.

We raised money in a variety of ways during fiscal year 1990. Wholesale and retail sales of books, pamphlets and theme-related items brought in \$47,312.00. Membership dues, donations and interest amounted to \$14,190.00. Our two art show and other events netted \$10,320.00. Total receipts for the year: \$71,822.00! We had to pay lots of bills from this amount, such as the purchase of the books that we sold (\$28,839.00), sales tax and insurance (\$4,022.00) and repay part of our start-up loan from another cooperating association (\$4,000). Even after expenses, we had enough net profit to print our Tideline newsletter (\$8,108.00), fund a petty cash allotment for environmental education operating costs (\$1,250.00), buy a copy machine for the Environmental Education Center (\$2,465.00) purchase microscopes, binoculars and various pieces of AV equipment (\$3113.00) and support the public use program with a great many miscellaneous purchases such as postage stamps, administrative supplies, etc. (\$9,180.00).

We continued operating a sales outlet at Klamath Basin Refuges during 1990. Thanks to the efforts of the staff at Tulelake Refuge, sales increased this year to \$9930.00. At the request of Gary Kramer, Project Leader at Sacramento Refuge, a decision was made to expand our operations to Sacramento Refuge. We once again modified our corporate papers, our liability insurance arrangements, our accounting and banking procedures and our sales

tax status to include a sales outlet at Sacramento Refuge. Outdoor Recreation Planner at Sacramento Refuge, Denise Dachner got off to a fast start with acquisition of inventory. With funds (\$575.00) from the Wildlife Society, she was also able to purchase bookshelves.

Once again, 1990 was a year of experimentation and expansion for our cooperating association. We decided to again hold our annual Christmas Wildlife Arts and Crafts Sale off the Refuge but held two shows at two local colleges instead of one. By doing this, we were able to reach people in the South Bay that would probably not otherwise come to the more northerly location of the Art Show. Due to an outstanding effort by many volunteers and a few staff members, we produced two well run and professional art shows. However, attendance was low at both shows and sales were slow (although we made more than any previous year (\$4,000.00)). We attributed both of these things to the general economic downturn. We experienced the same show down as did most merchants during the holiday season.

I. EQUIPMENT AND FACILITIES

1. New Construction

During the first half of the year, construction work was completed on the new I & R office that was started in 1989. Ceiling boards and miscellaneous trim were installed early in the year. Cabinets were built and installed as well.

In another carryover project from 1989, work was completed on the bridges and boardwalks in Avocet Marsh (Tract #102). Two major "work parties" involving both employees and volunteers were held in January and April. As a result of these efforts, visitors can now enjoy a loop trail utilizing levees, bridges and boardwalks.

Several teams of Boy Scouts and adults, organized by Eagle Scout candidates, undertook projects on the Refuge in 1990. One group constructed porches onto two mobile homes used by refuge interns. The porches replace rickety "temporary" steps that had been in use for several years. Another Scout group built a trail from the afore-mentioned mobile homes to Marshlands Road, for the benefit of interns walking to work. A third group created a small (three-vehicle) parking area just outside the Refuge entrance gate. This is for the use of evening and holiday visitors who would otherwise find the gate locked and no parking available. Maintenance worker Beth McCoy worked closely with the Scouts in all instances to provide advice and insure quality and control.

A number of projects were accomplished in and around the "Old Pumphouse" environmental education station. A small outdoor amphitheater was constructed using both staff and volunteer labor. Volunteer Norton Bell did the majority of work on this project.

In addition, a site was graded for a proposed "environmental education pavilion" (covered deck with tables and benches) that will be built in 1991 if finances permit. Finally, eight step-stools were constructed to allow our youngest visitors to climb up and peer through the dissecting scopes.

Numerous carpentry and cabinet-making projects were completed, including various cabinets and storage shelves for refuge headquarters, storage cabinets and a bookcase for the Visitor Center's "Kids Corner," an entrance sign and a brochure shelf for the Environmental Education Center, and a pedestal for a memorial plaque honoring Sandra Kinchen, a refuge volunteer who died in 1990.

2. Rehabilitation

The major rehabilitation project of the year was the installation of a new roof on the Environmental Education Center. The old shakes were removed, and heavy-duty asphalt shingles installed in their place. Rainier Roofing Company of Newark, California did the work.

The large circular island in the Visitor Center parking lot was landscaped with some 300 specimens of dwarf coyote bush and ground-hugging ceanothus. All of the work was done by elementary school children as an "Earth Day" project, using plants acquired at "cost" from the California Conservation Corps native plant nursery. Prior to this landscaping project, the parking lot island had turned into an unsightly jungle that blocked visitors' view of the path to the Visitor Center and created a safety hazard by obscuring drivers and pedestrians views of one another.

A good deal of used furniture was acquired during 1990 from the Environmental Protection Agency and various military bases. This included several beds that were sent to the Farallon Islands; chairs, desks, bookcases, file cabinets, and typewriters that were put into use in refuge offices. Tables, workbenches, and steel shelving that were utilized at the maintenance shop.

Also acquired was a child-sized table and set of oak chairs that were put into use in the Visitor Center's "Kids Corner." Some of this furniture had to be repaired or refinished before being placed into use.

Miscellaneous rehabilitation projects accomplished in 1990 are briefly described below:

1. Several old and deteriorated signs around the Visitor Center were replaced with new ones made at the National Park Service sign shop in San Francisco.
2. Wire mesh was installed in several places under the Student Conservation Aides' house trailers to discourage foxes from denning in the insulation underneath the floors.
3. The gravelly shoulders of Marshlands Road in the vicinity of the Visitor Center were scarified to encourage plant growth. Wood chips and leaf debris were "stirred in" to add some organic matter to the road shoulders.

3. Major Maintenance

Major maintenance in 1990 included such categories as pump repair and replacement, fence and gate repair boat maintenance and refuge clean-up projects.

Several pumps of various types were repaired or replaced this year. The sewage lift station pumps at the Environmental Education Center were replaced by a contractor at a cost of \$4800. They were ten years old and not working properly, leading to concerns about sewage backups and unflushable toilets. Two hot-water circulating pumps, a part of the heating system at Refuge Headquarters, were replaced. The Knapp Property pump, which fills the ponds there with fresh water, was repaired and placed into intermittent service. Finally, a portable fire pump was taken to Valley Tool Company in Modesto for an overhaul.

On the annual Coast Clean-up Day, September 22, 1990, volunteers and staff members turned out to pick up trash and recyclables along tails bordering San Francisco Bay. The city of Fremont provided two dump trucks (with drivers) for the occasion. Waste Management Incorporated donated two 30 cubic yard dumpsters and Carl's Jr. provided free refreshments to all. Over 50 cubic yards of litter was removed from the Refuge, and three truck loads of tires, glass aluminum and plastic were recycled. Many staff and volunteers participated in a maintenance/clean-up day at Salinas River Wildlife Management Area on October 16.

Maintenance staff spent several days at Antioch Dunes NWR during the spring repairing vandalized and deteriorated boundary fences. Numerous faded and vandalized signs were replaced as well, and a good deal of trash was picked up and removed from the Refuge.

An intoxicated driver in a delivery van plowed through our front entrance gate one night in June. Apparently not finding the Refuge to his liking, he turned around and plowed through the

exit gate! Both gates were destroyed in the incident. The truck was disabled and found abandoned near the Refuge entrance and its bumper was seen protruding from a nearby mudflat. One gate was repaired, and the other replaced, through the efforts of a local metal shop and the Refuge maintenance crew.

4. Equipment Utilization and Replacement

A good deal of military surplus equipment was acquired during 1990, primarily from Fort Ord and Mare Island Naval Shipyard. The Refuge acquired a 1976 3/4-ton stake truck, six-wheel all terrain vehicle and two 12-foot aluminum runabout boats with trailers. A wide variety of tools were also acquired including three "pioneer tool kits" containing forestry and fire-fighting tools, nine more-or-less complete automotive mechanic tool chests, a 6-inch jointer, 18-inch planer, paper saw, power saw and portable generator. In addition, a variety of furniture, both military surplus and E.P.A. surplus, was acquired for use at Refuge headquarters.

The Grad-All was shipped to Humboldt Bay NWR. The Refuge removed the following vehicles from service in 1990: two Dodge pick-ups, Dodge Ramcharger, Chevrolet Vega and AMC Hornet. The Ramcharger and one of the pick-ups were sold; the remaining vehicles were parked in the "bone yard" pending their disposal.

A new 3 H.P. Delta "Unisaw" was purchased to replace an old Sears table saw that "self-destructed" in April.

J. OTHER ITEMS

4. Credits

While the entire staff had input and assisted in roughing out this 1990 edition, the following staff members were responsible for the various sections as follows:

Sections A, B, C - all

Section D.5 - Jean Takekawa

Section D.5g - Doug Roster

Section E.1, E.5 - Carolyn Wang

Section E.2, 8 - Ben Crabb

Section E.4 - Sheila McCartan

Section E.6 - Bob Bolenbaugh

Sections F & G - Jean Takekawa

Section H.1 - John Steiner, Fran McTamaney

Section H.2, 3 - Fran McTamaney

Section H.4,5,6,7,9,11,12,13,14,16,18 - John Steiner

Section H.8 - 9 - Jim Ferrier

Section H.17 - Bob Bolenbaugh, Barry Tarbet

Section I - Mike Bitsko, Tom Lievsay

Editing was done by Francis Maiss and Jean Takekawa. Typing was done by Joan Dawson.

ANTIOCH DUNES NATIONAL WILDLIFE REFUGE

Contra Costa County

ANNUAL NARRATIVE REPORT

Calendar Year 1990

U.S. Department of the Interior
Fish and Wildlife Service
NATIONAL WILDLIFE REFUGE SYSTEM

INTRODUCTION

Antioch Dunes NWR was established in 1980 to protect a unique riverine dune ecosystem. Located along the San Joaquin River, the refuge encompasses approximately 55 acres divided into two separate tracts, known as the Stamm (41 acres) and Sardis (14.29 acres) Units. This refuge contains flora and fauna found nowhere else in the world. Two endangered plants and an endangered butterfly receive protection on this refuge. These few acres of remnant dune habitat support the last natural populations of Antioch Dunes evening-primrose, Contra Costa wallflower and Lange's metalmark butterfly.

Very little of the original dune habitat remains. The majority has been lost through industrialization, sandmining, agricultural conversion, off-road vehicle use, and other human disturbances. These practices are responsible for the introduction and encroachment of exotic plants, which has significantly altered the remaining dune habitat.

Antioch Dunes NWR represents the first refuge in the United States established to protect endangered plants and insects.

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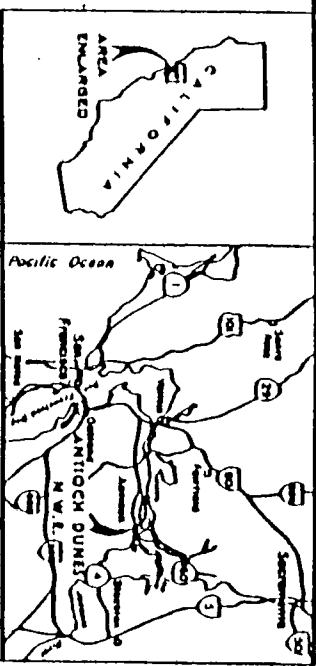
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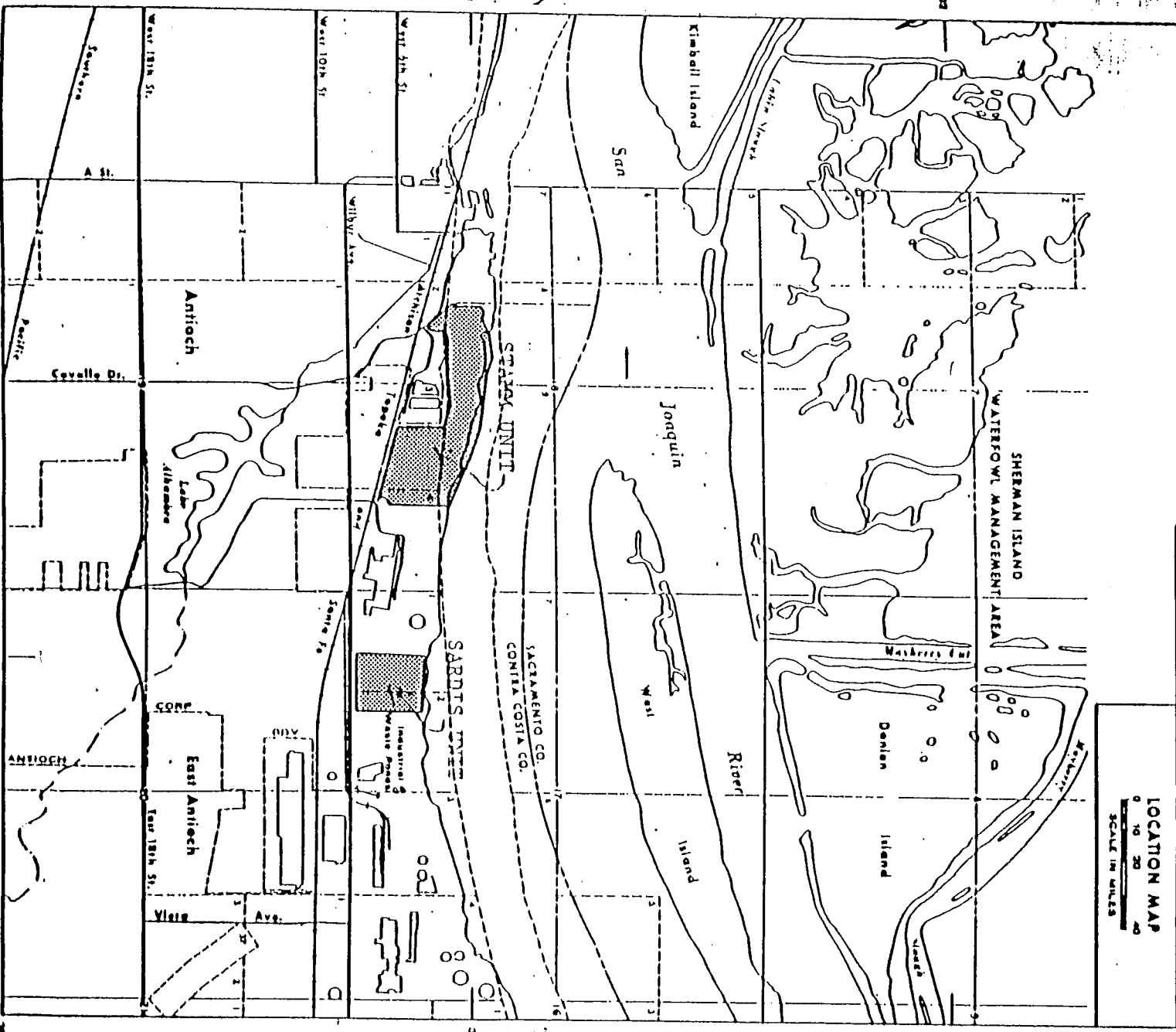
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K. FEEDBACK

FIGURE 10. WOLFFER SERVICE



REFUGEE AREA



LOCATION MAP

0 10 20 40

SCALE 100 MILES

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COMPLETED HIS REALTY PROM
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SECRET

A. HIGHLIGHTS

- Results of Lange's Metalmark butterfly surveys indicate that numbers continued to increase (Section G.2).
- Pacific Gas and Electric Company (PG&E) donated sand to the USFWS to be used for creation of several test dunes on PG&E and refuge property. Refuge personnel supervised the project and PG&E drivers and trucks were used to haul sand to the sites (Section E.7.).
- Buckwheat, Contra Costa wallflower, and Antioch Dunes evening-primrose seedlings were planted during January/February 1990. Survival of buckwheat and wallflower seedlings was remarkably high (Section F.6).

B. CLIMATIC CONDITIONS

Precipitation for 1990 was much lower than average, with the only significant rainfall occurring in late January/early February. This was the fourth year of a widespread drought occurring in the western United States. Growth of annual grasses was not as vigorous as in 1989, probably attributed to decreased seed germination caused by the drought. Conditions throughout the growing season were very dry and native plants did not flower as impressively as in past years, nor did they bloom for as long a period. Fast growing, drought-resistant plants, such as Russian thistle, thrived this year since they were subjected to less competition from slower growing natives.

D. PLANNING

2. Management Plan

In accordance with a past amendment to the PG&E Cooperative Agreement, refuge lands and adjacent PG&E lands are managed as an ecological unit. The amendment was necessitated by the establishment of an access corridor to PG&E's east tower. This action was approved through the Section 7 process and PG&E felt that they needed to formally address this issue as an amendment. The amendment calls for the refuge to transplant any primrose and wallflowers from the access corridor and established a fund to mitigate for plants that are displaced (Section F.6). PG&E provided \$2,000.00 to the Refuge to offset costs associated with the access corridor.



Antioch Dunes NWR was established for the protection of the Contra Costa wallflower, Antioch Dunes evening-primrose, and Lange's Metalmark butterfly (JA).

4. Compliance with Environmental Mandates

Approval for several refuge projects was gained through the Section 7 process in 1990. One project involved use of the herbicide GARLON for the purpose of controlling two species of exotic trees (see Section F.10.). The other project is a cooperative venture between the refuge and PG&E and involves the creation of additional sand dunes in habitat presently occupied by exotic plants for the purpose of increasing habitat suitable for natives and endangered species (see Section F.6.). Creation of two test dunes was approved through the Section 7 process, but additional work is subject to future evaluation and approval.

5. Research and Investigations

Dr. Jerry A. Powell, U.C. Berkeley, completed an interim report on the Microlepidoptera (small moth) fauna of ADNWR. The report was submitted in fulfillment of conditions in his permit to conduct research, originally issued as Permit No. SFB-1261-89-08. During 1990, he and his assistant made 10 visits to the refuge for the purpose of collecting larva to be reared in the lab for species determination. Blacklight sampling, conducted on two occasions, resulted in the addition of 26 additional species to the inventory. Dr. Powell concludes that surviving Microlepidoptera are mainly those that depend upon relatively few trees and woody shrubs. In 1991, he plans to survey specific plants that have been overlooked in the past and are suspected to be hosts of species known at the refuge. A final report will be prepared next fall.

E. ADMINISTRATION

1. Personnel

Antioch Dunes NWR is administered as a subunit of the San Francisco Bay NWRC. No permanent staff are stationed at the refuge.

4. Volunteer Programs

Volunteers assisted on a number of refuge activities in 1990 including planting of native and endangered species, exotic vegetation removal, collection of native plant seeds, endangered plant and butterfly surveys, and maintenance projects. Total volunteer time contribution for the year was 256 worker-hours.

7. Technical Assistance

The USFWS manages two PG&E parcels adjacent to the Sardis parcel and refuge staff frequently provide technical assistance to PG&E for projects involving PG&E owned lands. This year the refuge took part in a pilot project for native riverine dune restoration. Refuge staff provided endangered plant and animal expertise, planned the configuration and location of the test dunes, and supervised project activities. PG&E provided use of their trucks and drivers to haul approximately 60 truckloads (300 cu. yds.) of sand and deposited it according to refuge plan.

8. Other Items

Revenue sharing payment in the amount of \$13,291 was presented to Contra Costa County during 1990.

F. HABITAT MANAGEMENT

6. Other Habitats

In August 1989, seeds from the Contra Costa wallflower, Antioch Dunes evening-primrose, Naked-stemmed buckwheat, and several other native plants were taken to the Napa State Nursery to be propagated for transplant onto ADNWR and adjoining PG&E property. Chris Sauer, of the California Conservation Corps, supervised all planting and handling of these species. Germination rates for the wallflower were found to be quite high, but primrose germination was very poor.

The resulting seedlings, which included 377 wallflowers, 12 primroses, 1200 buckwheat, and 800 other natives were planted in late January/early February 1990. Refuge biologists supervised the planting, which involved many volunteers, PG&E personnel, and other refuge staff. Most wallflowers were planted either on the river-facing slope or the west bluff above the Sardis Pit on the PG&E East parcel. Buckwheat and the other natives were planted in sites on both PG&E parcels and in the Sardis Pit. Seedling survival (determined in April 1990) was found to be quite high for the wallflower (96%) and buckwheat (80%), but other natives were not as successful (approximately 40% survival). Most of the new wallflower seedlings (89%) and many buckwheat bloomed and produced seed this growing season, suggesting that nursery-grown plants have an accelerated growth/maturation rate.

Primrose seeds may require stratification and/or some other treatment prior to planting to increase the inherently low germination rate. In August 1990, primrose seeds were sent to Napa State Nursery to be propagated for transplant onto ADNWR in winter 1990/1991. Chris Sauer will supervise the germination tests and care of the seedlings.

Our existing cooperative agreement with PG&E requires the removal of all endangered plants and buckwheat from the PG&E East access corridor to prevent destruction by their work crews. In the winter rainy season, many primroses, wallflowers, and buckwheat were transplanted from the corridor to nearby suitable habitat. Plants that were transplanted during wet weather show high survival rates, but others are not as successful.

A sand dune habitat restoration project between the refuge and PG&E (E.7.) was initiated this year. The objective of this management action is to create an open sand dune area on the refuge and adjacent PG&E parcels, similar to that which occurred naturally, prior to sand mining activities. The new dune habitat will allow the reestablishment of native flora and fauna, including the three endangered species, in habitat that is presently dominated by exotic species. Initial experimental dunes were created on the PG&E west parcel and the in the Sardis Pit in December. PG&E hauled sand from the Contra Costa Power Plant and deposited it on the sites, creating dune contours. Endangered and native species will be established on the dunes next fall, after we determine whether exotic plant control necessary in the new habitat. More sand will be imported following determination of a successful method for reestablishment of native dune vegetation.



Naked-stemmed buckwheat, the primary host plant for the Lange's Metalmark butterfly, was planted in a "wagon-wheel" arrangement to create the configuration preferred by the butterfly (JA).



Contra Costa wallflowers were planted primarily on north and west-facing slopes where naturally occur. Survival of seedlings was very high and most plants bloomed and produced seed in April 1990 (JA).



The USFWS and PG&E cooperated on a pilot project to create new dune areas on refuge and PG&E lands for the benefit of endangered and native species (JA).

9. Fire Management

Two fires totalling approximately 9 acres burned on the Stamm Unit this year. Both fires burned portions of buckwheat stands, native brush species, and exotic grasses. The Riverview Fire Department responded to and extinguished these fires. One small fire (one acre) occurred on the Sardis Unit near the gate. Several oak trees and exotic grasses were burned.

10. Pest Control

Antioch Dunes NWR was established in 1980 to protect the remainder of a unique riverine dune system. Prior to acquisition, extensive sand mining had taken place on a large portion of the refuge, leaving much of the land in a disturbed, unvegetated state. The disturbed nature of the habitat encouraged colonization by invasive plant species, many of which are exotic. Several species of exotic grasses grow on ADNWR and compete with natives for sunlight and water. Control of grass is very difficult, since in most cases it grows in close proximity to native or endangered plants. No large scale control program has yet been established to control grass species.

Two species of exotic trees, Tree of Heaven (Ailanthus altissima) and Black Locust (Robinia pseudoacacia) occur on Antioch Dunes Refuge and adjacent PG&E parcels. Approval for use of this pesticide was gained through the Section 7 process (see D.4.). The objective of this management action is to control and eliminate these two species from refuge managed lands. This objective is consistent with operational goals of the refuge management plan, which require habitat enhancement for the benefit of endangered species. The introduced trees occupy critical habitat for all three of the endangered species at the refuge. Initial experimental treatments of GARLON were applied by refuge staff in the summer of 1990. Future large-scale control measures will be undertaken following our determination of the most successful treatment method.

Russian thistle (Salsola sp.) is a common exotic species found at ADNWR. Several areas, including both PG&E parcels, have dense patches of thistle. This past year volunteers weeded several of these areas before the thistle seeded out, in an attempt to reduce the potential seed stock in the soil. One large thistle-dominated area (PG&E West) was mowed and raked in conjunction with annual spring firebreak mowing. This treatment method was not determined to be successful, since much thistle grew up in this area later in the summer. Seed production of this species is so profuse that immense seed banks accumulate in the soil. Repeated cultivation of the soil will be required to reduce the thistle growth in selected areas.

G. WILDLIFE

1. Wildlife Diversity

In addition to the three endangered species, the Antioch Dunes NWR has many other unique flora and fauna. Antioch Dunes NWR harbors representatives of at least 24 insect taxa; 10 of these are endemic, six are known only from other imperiled habitats, and two (with wider ranges in pre-agricultural times) may now exist only on the refuge. Three species of reptiles reach their northernmost range on the refuge, including the glossy snake, side-blotched lizard and the legless lizard. Seventy-eight species of birds and eight mammals have been identified on the refuge since November 1983.

2. Endangered and/or Threatened Species

A. Lange's metalmark butterfly

Lange's metalmark butterfly (*Apodemia mormo langei*) was listed as an endangered species by the U.S. Fish and Wildlife Service on June 1, 1976 and critical habitat was proposed on February 8, 1977. The present range of this subspecies has been reduced to only 15 acres of suitable habitat, occurring on the refuge and adjacent PG&E property.

Population estimates for this species are illustrated in Figures 1 through 4. Estimates were derived from mark/recapture surveys conducted by Richard Arnold during 1977-1985 and by actual counts made by refuge personnel during 1985-90. Arnold's surveys were discontinued in 1985 due to the excessive amount of handling required to accomplish this work. Current surveys are conducted using several observers to count all butterflies within predetermined transects. This count is used as an index of the relative size of the annual butterfly population.

The largest increases in butterfly numbers occurred this year on the PG&E East parcel and the portion of the Stamm Unit designated as "Remainder of Stamm". The only decrease in numbers was observed in the Sardis Pit. The amount of suitable habitat in the Sardis Pit is quite limited due to past sand mining activities. Active enhancement is planned for 1991 in this area including creation of new sand dunes in previously mined areas and planting/seedling of buckwheat to provide additional habitat for the butterfly.

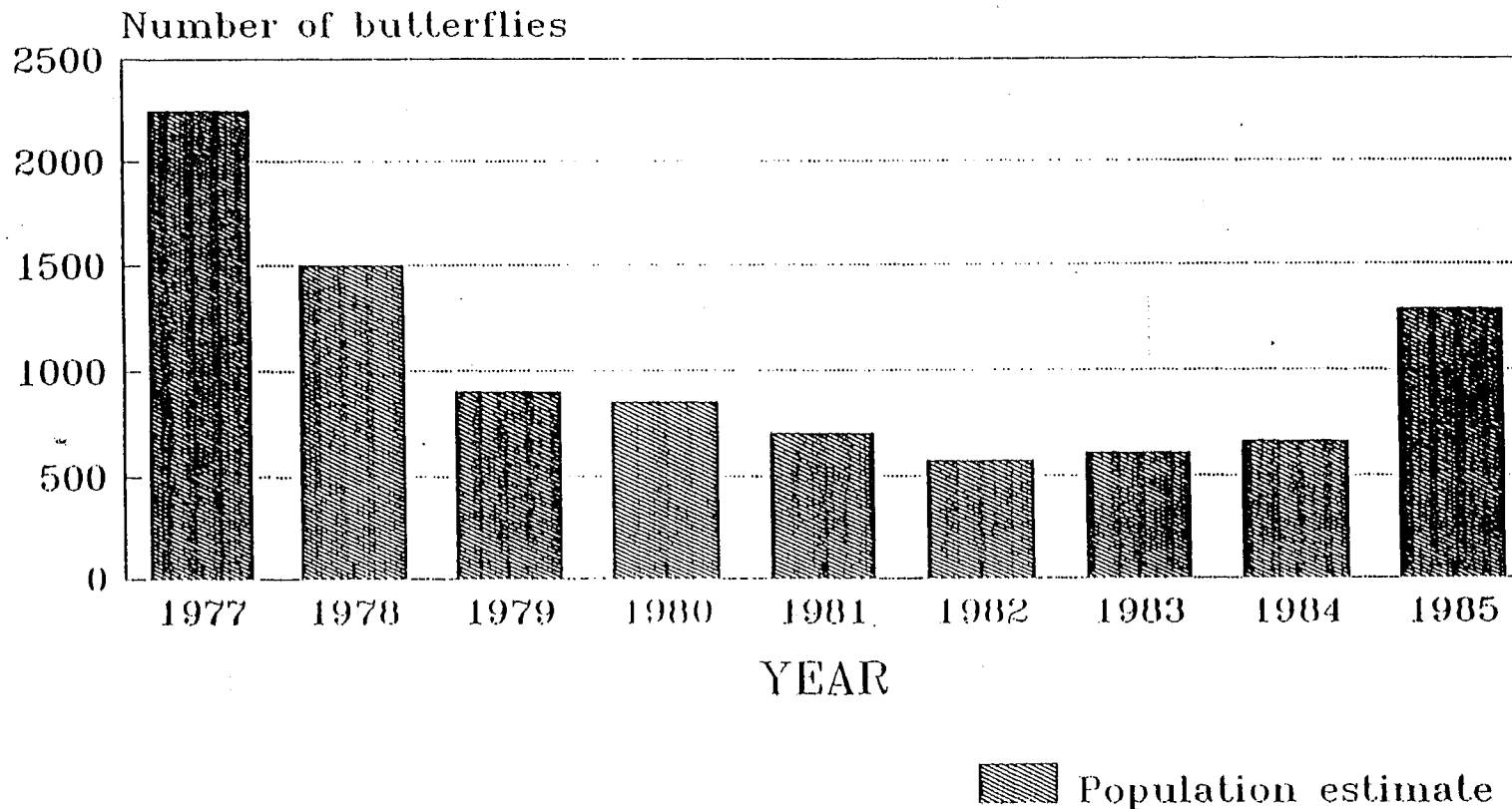
Flight stage of the Lange's Metalmark occurs in early August and lasts until late September. Peak populations usually occur during the first two weeks of September. The lifespan of an adult butterfly of this species is approximately one week. Lange's metalmark butterfly is a univoltine species, which means that only one brood is produced in a breeding season. Eggs are

laid throughout the flight stage on the lower stem axils of the host plant, naked buckwheat (Eriogonum nudum var. auriculatum). Eggs remain dormant until the rainy season, which usually begins in December. At this time, larvae hatch and crawl to the base of the plant where they overwinter. Larvae begin to feed on new plant growth as it becomes available in late fall or early spring. Pupation occurs in mid-summer in the litter at the base of buckwheat plants. New adults emerge in late summer.

Buckwheat is critical to management of Antioch Dunes NWR because the Lange's metalmark butterfly depends almost exclusively on this plant during all phases of its life cycle. Plants colonized by the endangered butterflies generally are older plants growing in clumps. It has been estimated that plants must be three years of age before they can support a viable butterfly population. However, as stands senesce, they gradually lose their importance to butterflies.

Buckwheat appears to be self-maintaining on several sites within the refuge. However, several areas that once were dominated by exotic plants are now managed to provide additional buckwheat colonies. The success in establishing new buckwheat colonies in the old vineyard site, and the appearance of butterflies just 2 years later, shows great promise regarding our abilities to restore and maintain good habitat.

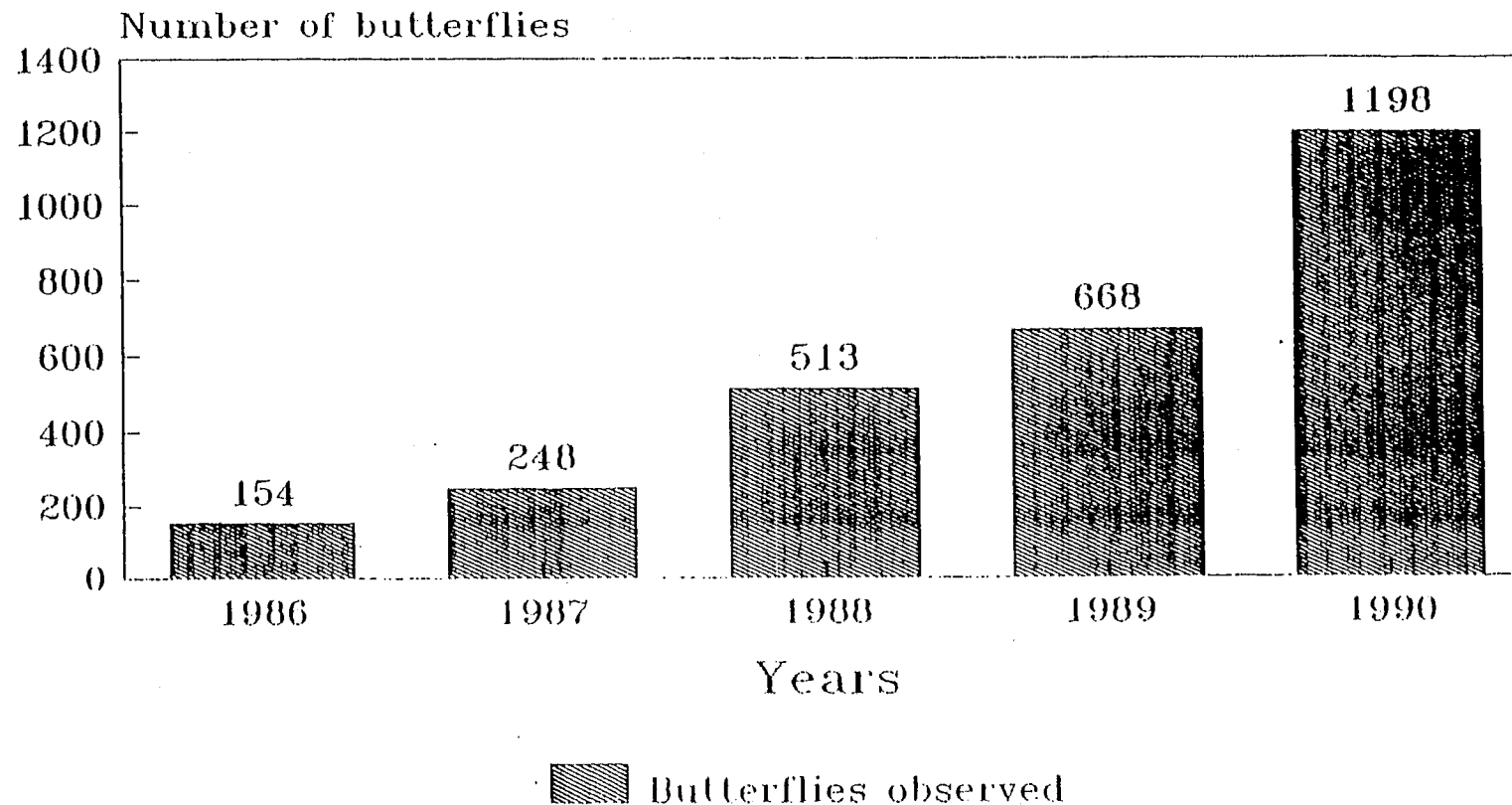
Figure 1. Antioch Dunes NWR
Lange's Metalmark butterfly
population estimates*



*Based on a mark/recapture index,
by Dr. Richard Arnold.

Mark/mb

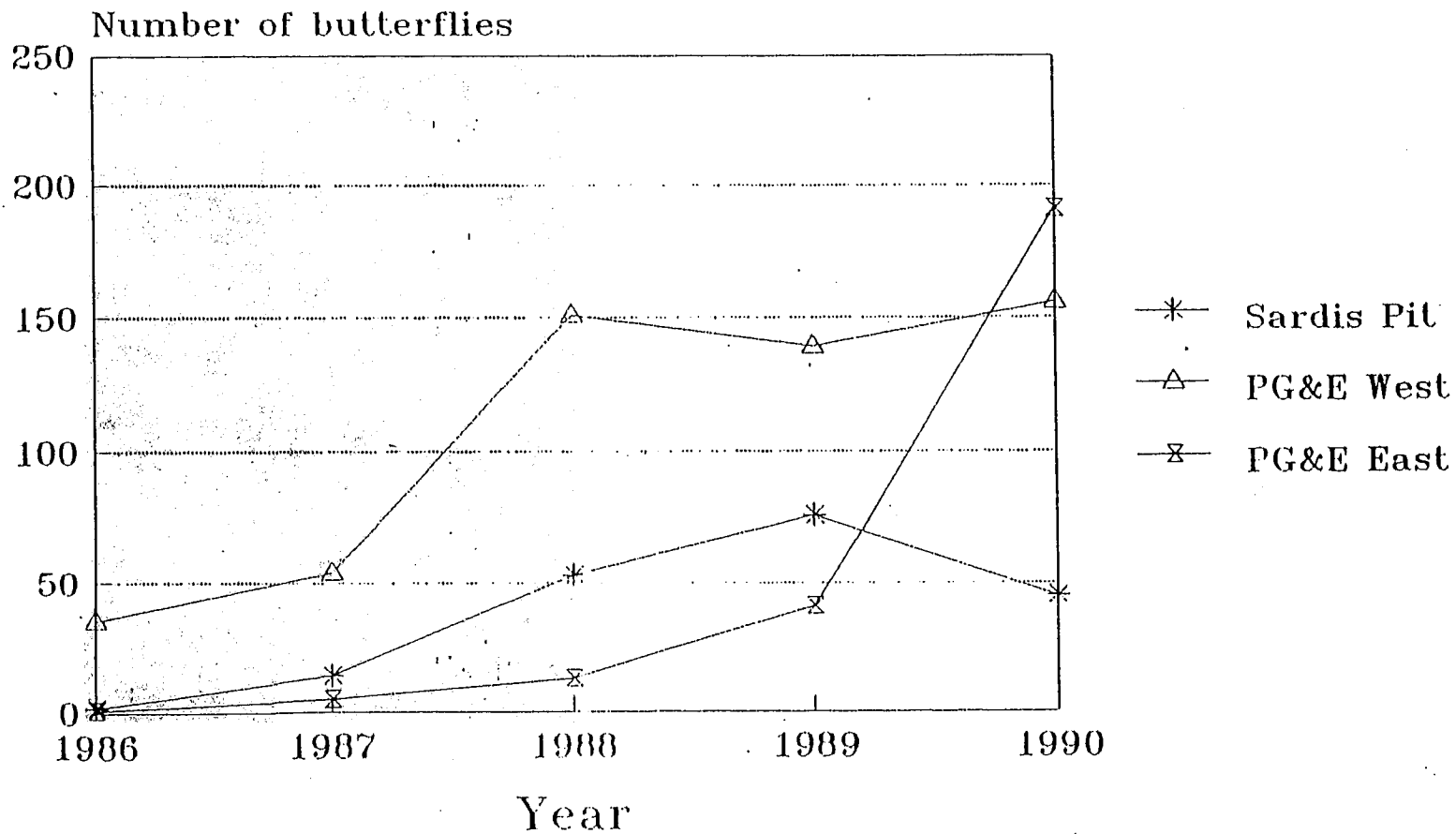
Figure 2. Antioch Dunes NWR
Lange's Metalmark Butterfly
Peak populations 1986-1990*



* Annual population index based
on peak number counted.

LMB Peaks

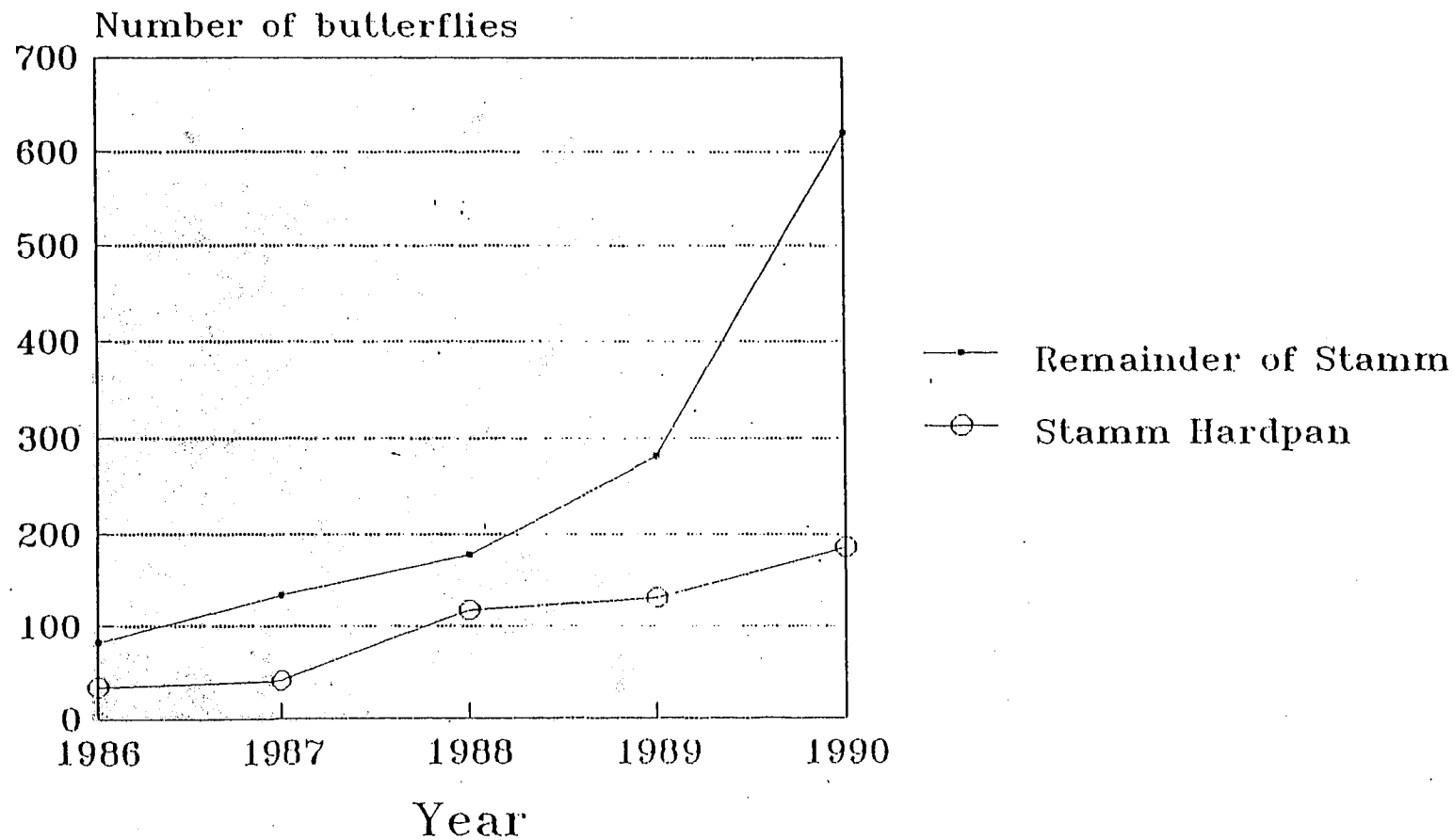
Figure 3. Antioch Dunes NWR
Lange's Metalmark butterfly surveys
by parcel*



*Annual population index based on
peak number counted.

BF/14

Figure 4. Antioch Dunes NWR
Lange's Metalmark butterfly surveys
by parcel*



*Annual population index based on
peak number counted.

B. Antioch Dunes Evening Primrose

Antioch Dunes evening primrose (Oenothera deltoides subsp. howellii) was listed as an endangered species on April 26, 1978, while critical habitat was determined on August 31, 1978. Population status of this species is illustrated in Figures 5 and 6. Unlike the other two endangered species found on Antioch Dunes, the Antioch Dunes evening-primrose (ADEP) is found at three other locations, Brannan Island State Recreational Area in Sacramento County, city of Rio Vista property, and Brown's Island in Contra Costa County. An experimental seeding of ADEP on Point Reyes dunes was unsuccessful.

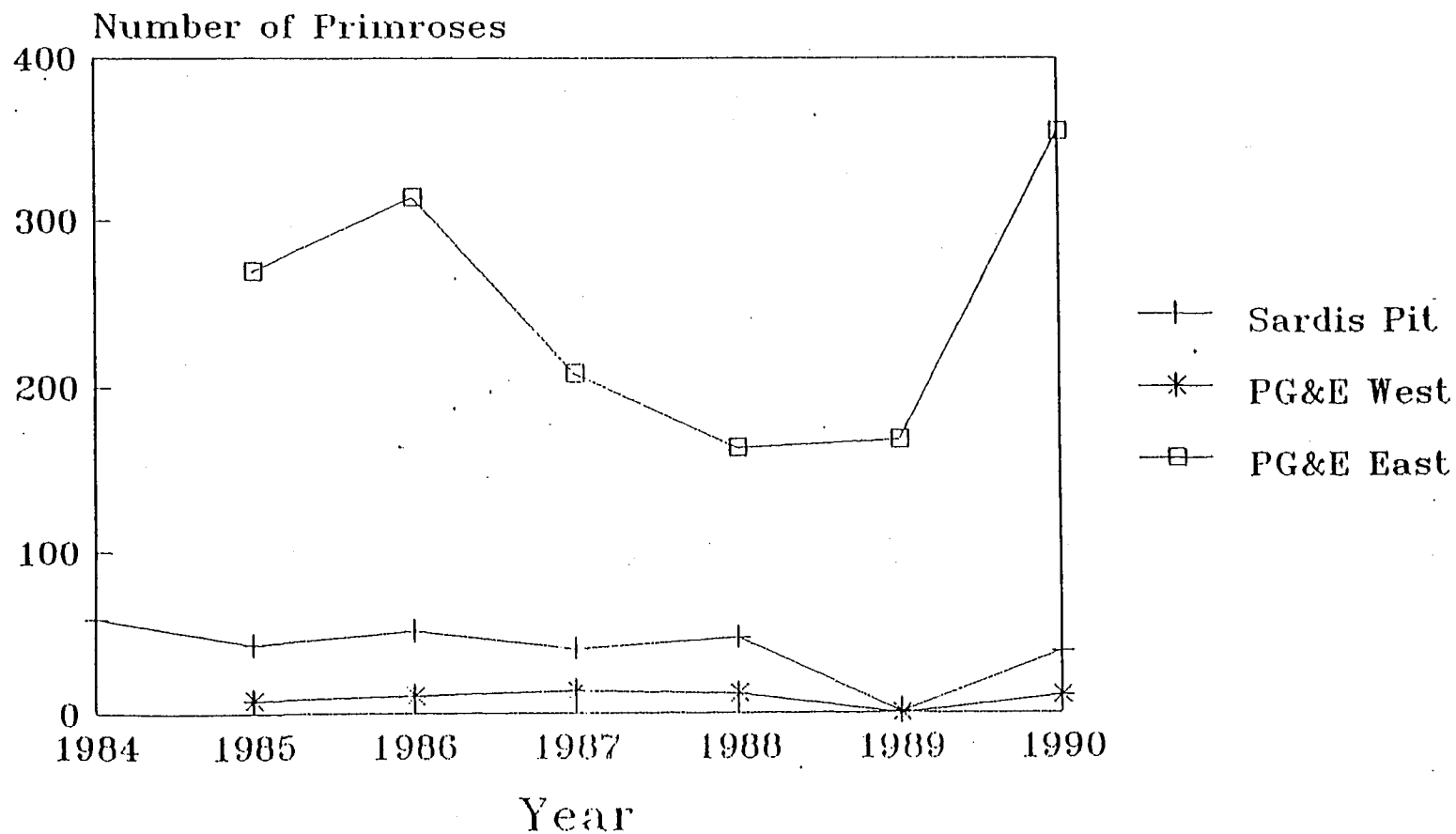
The feature that separates the subspecies found on Antioch Dunes from other closely related evening-primroses is its perennial habit. However, plant productivity reaches its peak in the second year. Thus, the proper designation of short-lived perennial is the best description of this plant.

Plants flower from March to May and again, briefly, in September. This species requires cross pollination for viable seed production. The plant may bloom the first year but blooms more profusely the second year. Most plants probably die during their second winter, however, some do survive beyond the second year in a reduced state of productivity.

The substrate favored by the ADEP is nearly pure sand. Studies of cultivated ADEP indicate that seedlings will not survive in an area where an adult plant has recently matured and died. This, undoubtedly, relates to the amount of soil nutrients available. Other observations indicate that ADEP responds favorably to disturbed sites.

Invasion of the dunes by exotic vegetation has stabilized soils and increased the competition for resources. Sandmining activity prior to refuge establishment greatly reduced the amount of habitat available to this species.

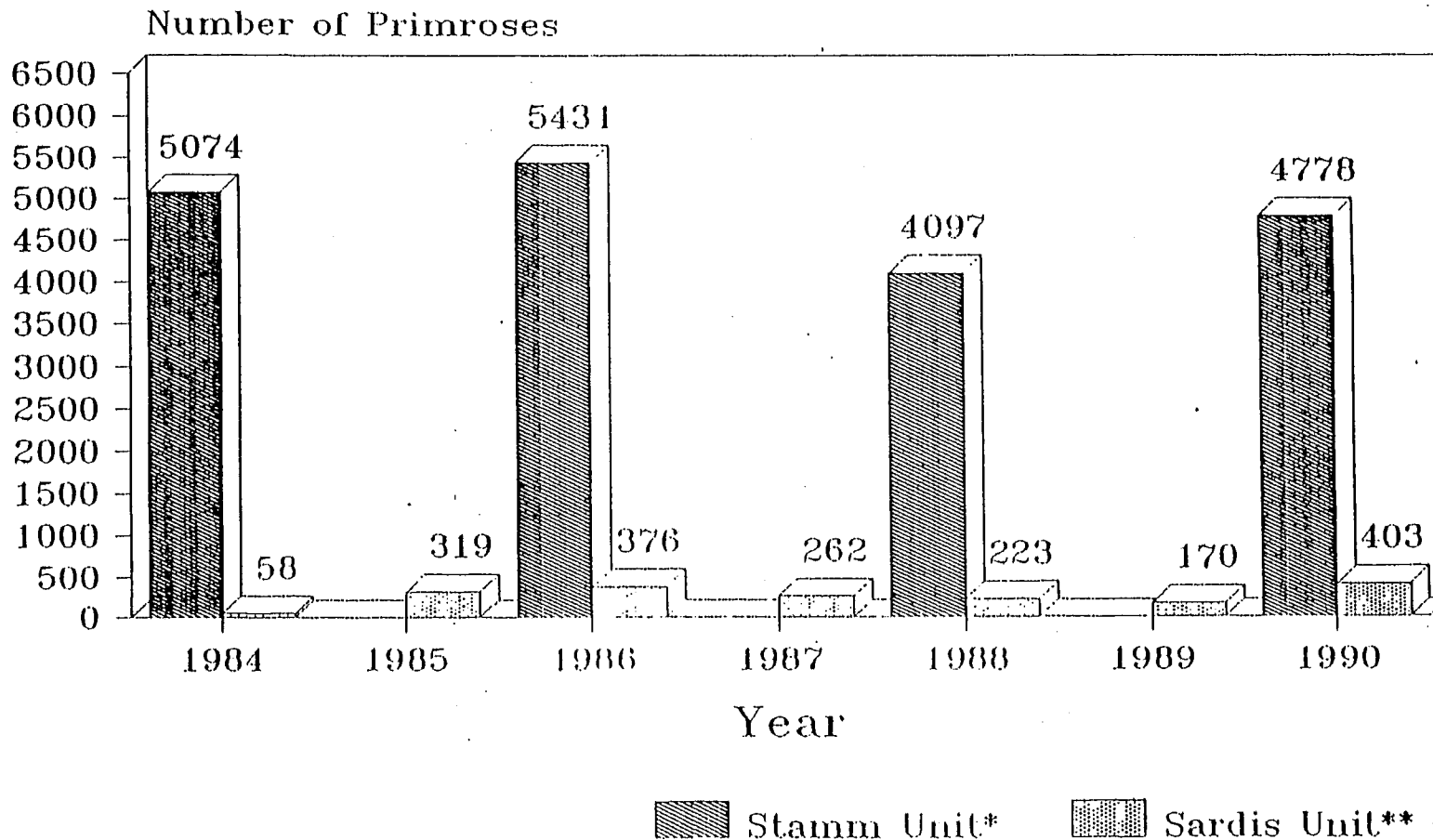
Figure 5. Antioch Dunes NWR
Antioch Dunes evening primrose surveys
on Sardis Unit and PG&E Parcels*



*Complete surveys conducted
yearly in these areas.

ADEP

Figure 6. Antioch Dunes NWR
Antioch Dunes evening primrose surveys



*Semi-annual complete survey

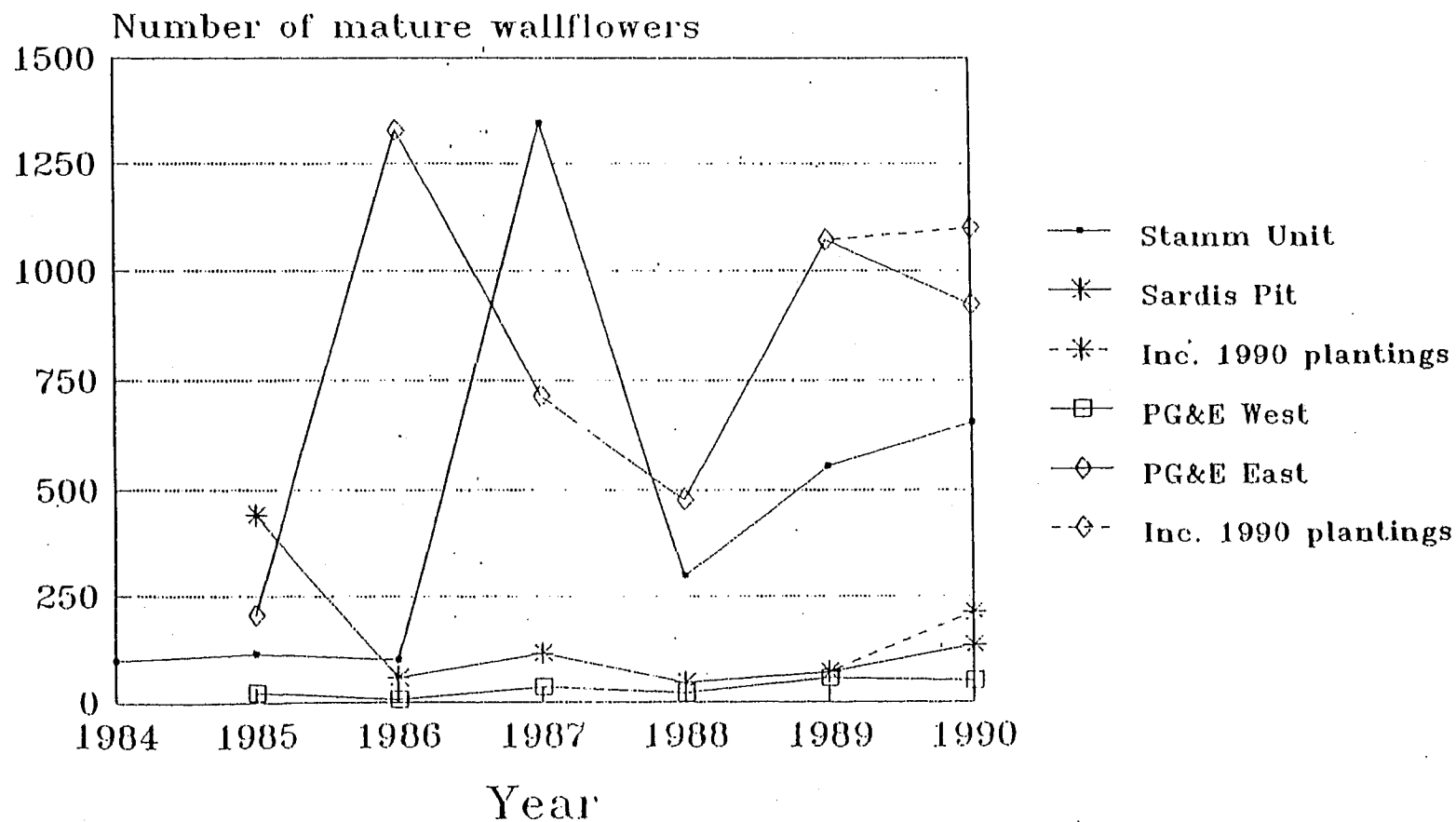
**Includes PG&E parcels, except in 1984.

C. Contra Costa Wallflower

The Contra Costa wallflower (Erysimum capitatum var. angustatum) was listed as an endangered species on April 26, 1978, and critical habitat was determined on August 31, 1978. No other natural populations of Contra Costa wallflower (CCW) are known to exist. The CCW is a biennial; that is, individuals die after setting seed in their second year. Population estimates for this plant are illustrated in Figures 7 and 8.

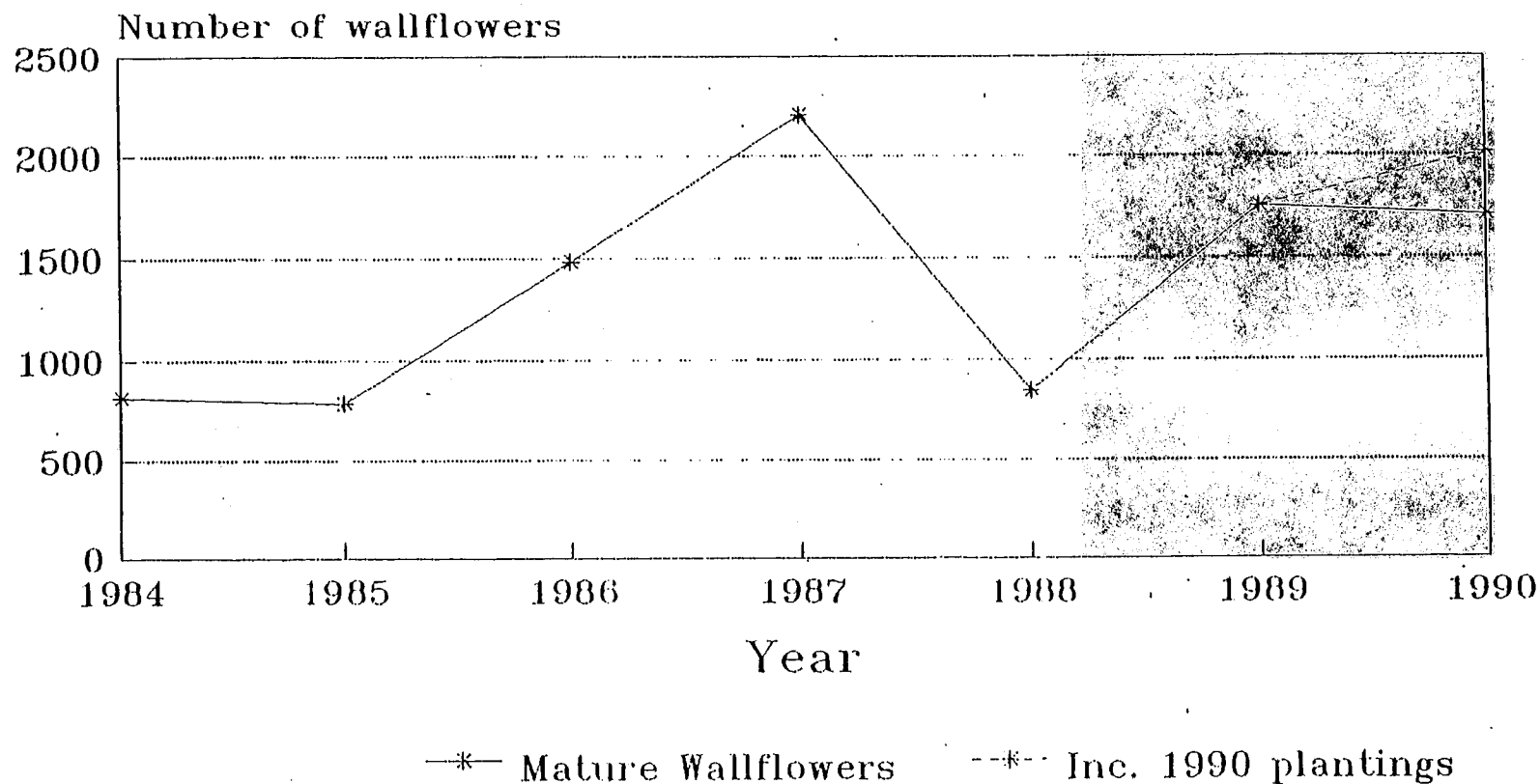
This species has been cultivated at Tilden Regional Park Botanic Garden. It was reported that CCW responded very favorably to cultivation. Again, this points to the importance of disturbance in management of Antioch Dunes NWR. CCW grows primarily on river-fronting, steep slopes and is more restricted than ADEP regarding areas it can successfully colonize.

Figure 7. Antioch Dunes NWR
Contra Costa wallflower surveys
by parcel*



*Dashed lines include 1990 plantings
on Sardis and PG&E East parcels.

Figure 8. Antioch Dunes NWR
Contra Costa wallflower
population estimates*



*Totals include mature (blooming or budding) plants only.

4. Scientific Collections

Seeds are collected from the two endangered plants, buckwheat, and other natives on an annual basis during the period of maximum fruit production. Most seeds are stored in paper envelopes at San Francisco Bay NWR headquarters for use in reseeded projects the following year. A small portion of the endangered species seeds are sent to the Rancho Santa Ana Botanical Garden in Claremont, California for long-term storage in their facility.

Stockpiled Contra Costa wallflower and Antioch Dunes evening-primrose seeds play a vital role in assuring the continued existence of these species. Because of their limited distribution and abundance, these plant populations are especially susceptible to catastrophic reductions in numbers due to fire, disease, pest infestation, weather, or other disturbances. This seed reserve can be used to repopulate the refuge or enhance existing plant populations.

H. PUBLIC USE

1. General

The refuge was officially closed to public use during October 1988 as the use was not compatible with refuge management objectives. Excessive vandalism, littering problems, and wildfires from fisherman's warming fires were adversely impacting endangered species habitat. Compliance with this closure has been good and no major complaints have been received from Antioch residents. Some trespass is occurring but littering and vandalism has greatly diminished.

I. EQUIPMENT AND FACILITIES

2. Rehabilitation

Delta Fence Co. repaired several breaks in the chainlink fence during summer 1990. PG&E paid for the repairs.

J. OTHER ITEMS

3. Credits

This report was prepared by Joy Albertson. Typing was accomplished by Joy Albertson and Joan Dawson.

FARALLON NATIONAL WILDLIFE REFUGE

San Francisco County, California

ANNUAL NARRATIVE REPORT

Calendar Year 1990

U.S. Department of the Interior
Fish and Wildlife Service
NATIONAL WILDLIFE REFUGE SYSTEM

REVIEW AND APPROVALS

REVIEW AND APPROVALS

FARALLON NATIONAL WILDLIFE REFUGE
San Francisco County, California

ANNUAL NARRATIVE REPORT

Calendar Year 1989

Refuge Manager

Date

Refuge Supervisor Review

Date

Regional Office Approval

Date

INTRODUCTION

Farallon National Wildlife Refuge was established in 1909 and is located approximately 28 miles west of San Francisco. It is comprised of four groups of islands including the North Farallons, Middle Farallons, and Noonday Rock which are all designated as wilderness areas. The South Farallon Islands were given refuge status in 1969 and is the largest group consisting of 120 acres and reaching a height of 370 feet. West End, a portion of the South Farallon Islands, is also designated a Wilderness Area. The refuge totals 211 acres.

The refuge comprises the largest continental seabird breeding colony south of Alaska. It supports 12 nesting species including the world's largest breeding colonies of ash storm-petrel, Brandt's cormorant, and western gull. The islands also support five pinniped species. After an absence of over 100 years, northern elephant seals returned in 1959 and now breed on the South Farallon Islands.

The Farallons are a granitic formation that is part of the Farallon Ridge. Shallow soils can be found scattered on some of the South Farallons. Vegetation is dominated by Farallon weed, an important nest building material for cormorants and gulls. Floral diversity is limited and is made up of a high proportion and number of nonnative species due to the large amount of human activity on the Southeast Farallon Island (part of the South Farallon Islands) since the 1800s.

Wildlife populations were heavily exploited in the late 18th and early 19th centuries for meat, hides, and eggs. Over-fishing of sardines reduced seabird food supplies. Some species were extirpated while others declined drastically. Historical estimates indicate that thousands of northern fur seals and as many as 400,000 common murrelets once populated the islands. An active Coast Guard station further impacted island wildlife and habitat until the full automation of the light station in 1972. While some species have recolonized the islands, others are slowly recovering. Wildlife remain vulnerable to the impacts of pollution, oil spills, and gill net fisheries. The Service has cooperative agreements with Point Reyes Bird Observatory and the U.S. Coast Guard to facilitate protection and management of the refuge.

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I. EQUIPMENT AND FACILITIES

1. New Construction.....	NTR
2. Rehabilitation.....	25
3. Major Maintenance.....	25
4. Equipment Utilization and Replacement.....	26
5. Communications Systems.....	26
6. Energy Conservation.....	NTR
7. Other.....	26

J. OTHER ITEMS

1. Cooperative Programs.....	NTR
2. Items of Interest.....	NTR
3. Credits.....	27

K. FEEDBACK

A. HIGHLIGHTS

- The 1990 seabird breeding season was one of the worst compared to previous years (1971-1989) (Section G.5).
- The Northern sea lion was listed as federally threatened in an emergency rule; numbers remained precarious at the Refuge (Sections G.2.C and G.9).
- Wildlife disturbance by boaters increased in 1990. A compromise proposal to restrict boating around Farallon NWR was achieved in December (Section G.11).
- The North Landing boom was successfully secured to prevent it from crushing the North Landing building (Section I.2).

B. CLIMATIC CONDITIONS

Temperatures are relatively constant throughout the year, seldom falling below 40 °F or rising above 60 °F. Most rainfall occurs in the winter. Summer moisture is usually limited to damp fog. Offshore fog banks frequently envelop the islands in dense fog.

Following three relatively dry and mild winters, January brought wetter weather including a storm on January 12-14 that produced 1.83 inches of rain. This included an unusual electrical storm that caused western gull mortality (Section G.5). However, the winter concluded with a very dry March; approximately one inch of rainfall was recorded compared to 5.31 inches recorded in March 1989. An unseasonably late winter storm produced 2 inches of rain on May 27-28 adversely affecting nesting seabirds (Section G.5). Extremely cold temperatures of 1.1 C were recorded on December 21-22. This was only the third time since 1972 that temperatures has been this low at the Farallons.

D. PLANNING

5. Research and Investigations

Farallon NWR is managed by the Fish and Wildlife Service out of the refuge complex headquarters. We hold a cooperative agreement with the Point Reyes Bird Observatory (PRBO) for their biologists to be present on the island year-round. They provide day-to-day resource protection, routine maintenance, and also conduct or monitor research approved by the Service. The refuge provides funding, maintenance support, and direction and some support for studies. PRBO studies were numerous, some of which are long term projects that have been ongoing since the 1970s. They included:

Population demography of the western gull: This study examined breeding biology, effects of senescence and quality of mate on reproductive success, and reproductive life span. Monitoring known-age gulls provides the core of this project.

Density-dependent effects on the population demography of northern elephant seals: Determining carrying capacity and the importance of density-dependent effects on population regulation are objectives of this long term project.

Reproductive ecology of the northern elephant seal: Multiple objectives focus on the effects of age on reproductive success and the implications of a changing age structure. Methods included tagging, marking (with dye or bleach), and censusing elephant seals during the winter breeding season (Section G.9). Studies have been conducted annually since the Farallons were recolonized by seals in 1972. Because the population is small and a pool of known-age seals has developed over many years, a unique opportunity for long-term population studies exists.

The relationship of age to breeding effort and success in Brandt's cormorants: The colony at the Farallons represents the largest single Brandt's cormorant colony in the world. Life-history parameters are being investigated such as age of maturity, fecundity, longevity, mate/site fidelity, survival to breeding age, and how these relate to breeding effort and success. Their relationship to annual ocean conditions are also being examined. Methods included monitoring reproductive success of known-age birds, including several that were hatched in the early to mid-1970s.

Foraging ecology and diet in pigeon guillemots: Begun in 1989, this study was designed to investigate the foraging ecology and diet of pigeon guillemots. Telemetry was unsuccessfully tested on two birds in 1989. Unfortunately, both birds abandoned their breeding sites after a glue-on radio was attached. However, the diet portion of the study has been continued. Extensive diet watches were conducted at known sites. Observers recorded site number, any band markings, time, and the prey species being taken to breeding sites. In 1990, pigeon guillemots fed primarily on octopus, sculpins, and flatfish.

Population size and diet of rhinoceros auklets: A dramatic increase in rhinoceros auklet numbers was first observed in 1986 and continued in 1987. The objectives of this study are to more accurately determine population size and describe and quantify diet. Methods included mark-recapture of birds using mist nets at the entrance to breeding burrows at several sites, and collection and identification of food items carried in by netted birds. This study will be continued as part of long-term studies. However, study sites were reduced from four to three to reduce impacts to rhinoceros auklets.

Some new studies were initiated by PRBO in 1990:

Colony Formation in Cassin's Auklet: This study was designed to investigate the impacts of western gull predation on Cassin's auklets. Specifically, it addresses the question of whether gulls prevent auklets from colonizing areas which have previously supported high densities of nest burrows. Two plots were constructed using stakes and low, suspended ropes that effectively excluded gulls. Burrow density was determined and will be monitored over the next several years.

Population status of the ashy storm-petrel: Gerry McChesney, in collaboration with PRBO, conducted mist-netting for mark-recapture studies to investigate ashy storm-petrel population size. He also collected western gull pellets to investigate the incidence of ashy storm-petrels in gull diet. Finally, he experimented with the use of playback tapes to search for elusive petrel nesting sites. This proved to be a very effective technique. Many new breeding sites were detected. This study also documented the presence of a fork-tailed storm-petrel with a brood patch, the first evidence of breeding for this species at the Farallons. Mark-recapture data will be analyzed in the future.

Nest site selection of crevice nesting alcids on Southeast Farallon Island: Ian Drew, in collaboration with PRBO, conducted this study as a senior thesis. He compared nesting sites of pigeon guillemots, rhinoceros auklets, and Cassin's auklets. Measurements included orientation, elevation, width, depth, flora around nest site, among other parameters. Field work was completed in fall 1990.

Migration, dispersal, and survivorship of coastal central California land birds: Land birds were monitored daily and most intensively during spring and fall migration (Section G.7). Objectives are to investigate factors responsible for relative abundance, numbers and timing of various species, and describe relationship between weather and timing and intensity of migration.

The Fish and Wildlife Service conducted the following study:
Survey of seabird colonies of northern and central California in 1989: The Refuge assisted the Research Division in conducting and administering a comprehensive survey of all seabird colonies in central and northern California. The project was led by Harry Carter, Northern Prairie Field Research Station - Dixon. Funding was provided by the Minerals Management Service (MMS). This was an update of a survey conducted in 1979-1980. The refuge conducted and paid for all aerial surveys, administered part of the funds and purchasing, provided housing and logistical support at Humboldt Bay NWR, assisted in negotiations with MMS and PRBO, and provided two vehicles for field work.

Field work was conducted from April to September. Methods included ground surveys by boat and from the mainland, from Point Conception to the Oregon border. The refuge staff flew and photographed all common murre and cormorant colonies within that area, including those at Farallon and Castle Rock NWR's.

The PRBO collaborated on the study and was provided with \$15,000 to fund additional field work required. They conducted correction factor counts on Farallon NWR (South Farallon Islands). A draft report of results was completed in 1990.

Thermal biology of reproduction in western gulls on the Farallon Islands: Zoe Eppeley, Ph.D. student, Department of Ecology and Evolutionary Biology, University of California, Irvine. This study was part of a doctoral study investigating thermal biology in breeding western gulls. Eppeley examined various environmental parameters in gull nests during the 1990 breeding season. Results will be available in 1991.

E. ADMINISTRATION

4. Volunteer Program

During the calendar year 1990, approximately 46 volunteers donated 14,142 hours of service at the PRBO research station on Southeast Farallon Island. Volunteers assumed a variety of responsibilities including assisting with marine bird and mammal research, censusing, collecting meteorological and oceanographic data, and performing facility and equipment maintenance and construction.

5. Funding

The PRBO continued to receive the equivalent of a GS-5 and GS-7 salary from the Service. Beginning in 1989, an additional \$6,000 was provided to offset food costs, based on camp rate per diem. Thus, approximately \$53,000 was paid to PRBO in FY90.

Several meetings were held with the PRBO regarding funding levels and the Cooperative Agreement in 1989. They expressed interest in revising the Cooperative Agreement, and obtaining an increase in funding. Because there was little potential for funding increases by the Service, efforts to revise the agreement were discontinued by year's end.

F. HABITAT MANAGEMENT

1. General

The refuge consists of 211 acres of mostly rocky and marine habitats. In addition, the Southeast Farallon Island (SEFI), where all facilities and PRBO staff are located, supports a soil-covered marine terrace. Island flora includes 45-50 species. Rocky habitats provide nesting areas for many seabird species including common murre and Brandt's cormorants. Soils provide habitat to burrow-nesting species such as Cassin's auklets. Most rocky and marine habitats are largely undisturbed. However, habitats which can support plant life on SEFI have been significantly impacted by a history of human occupation and disturbance. Many exotic plant species such as weeping grass (Bromus diandrus) flourish on the island and in some areas, have displaced the native Farallon weed (Lasthenia-minor).

3. Forests

The "woodland habitat" on SEFI consists of several transplanted Monterey cypress and one low-growing Monterey pine which are able to tolerate the strong prevailing winds. These small trees, together with the remains of two larger cypress which toppled over during the storms of November 1981, serve as veritable magnets to migrant landbirds. During the spring and fall, large numbers of vagrants can be found in and around these trees, thus facilitating trapping and censusing of these birds.

10. Pest Control

FWS and PRBO biologists and volunteers continued to control exotic vegetation to prevent encroachment across the marine terrace and up Lighthouse Hill. Species controlled by hand pulling included broccoli (Brassica moleracea), ice plant (Mesembryanthemum chilense), New Zealand spinach (Tetragonia tetragonides), sow thistle, and Lavatera arborea. In August, for the second year Refuge staff chemically treated all New Zealand spinach on the island with Round-up. Test plots treated in 1988 showed Round-up to be effective at controlling this rapidly spreading exotic. Hand pulling appeared less effective, possibly because disturbance of the soils encouraged germination of new plants. A large seed bank exists in the soils. Photopoints were photographed to better determine the effectiveness of our control program. New seedlings were pulled throughout the winter.

12. Wilderness and Special Areas

In 1973, Middle Farallon Island, North Farallon Islands, West End (part of the South Farallons), and Noonday Rock were designated a National Wilderness Area. The largest island, Southeast Farallon, was excluded from this designation because of the structures and people living on the island. The islands within the wilderness area serve as marine bird and mammal breeding areas. West End Island is accessible to PRBO researchers to conduct elephant seal research in the winter. However, the 1989-90 winter was the second year of a five-year phase out of intensive research on West End. We established this schedule in order to allow PRBO to gather a larger dataset on known-aged elephant seals, while allowing an eventual reduction of human impacts on West End (Section G.9). The remaining islands are not accessible to humans due to rough seas and rocky cliffs. Periodic aerial surveillance is the only management practiced on these islands, therefore the wilderness designation does not affect refuge operations.

G. WILDLIFE

2. Endangered and/or Threatened Species

a. American Peregrine Falcon

As many as four peregrine falcons were observed in January through March. Two to four individuals were commonly present throughout the winter months. Cassin's auklets were a primary food source on SEFI based on numerous carcasses found at feeding sites. In addition, several common murre and rhinoceros auklets were preyed on by peregrines during the winter months. In particular, the small Upper murre colony was heavily impacted by peregrines. As many as six were taken by peregrines there in January, including several banded birds.

b. California Brown Pelican

Brown pelican numbers peaked at 1610 in October, up from 1058 in 1989 but much lower than the peak of 3400 in 1987. Pelican use is concentrated in the fall and winter months when birds commonly roost on the islands. Year to year fluctuations in numbers are probably related to the relative abundance of food resources in coastal and offshore zones. Numbers were unusually high in January through March (Table 1).

Table 1. Peak monthly population estimates of California brown pelicans on SEFI.

Month	1984	1985	1986	1987	1988	1989	1990
January	0	2	2	0	50	250	700
February	118	0	0	0	82	26	560
March	221	1	18	1	15	33	1200
April	34	1	3	6	11	41	49
May	3	38	122	68	222	146	28
June	10	405	150	250	348	134	22
July	190	592	50	800	127	NA	150
August	1000	1300	200	1144	785	400	530
September	5670	2257	1850	1160	2000	634	979
October	2647	2700	1065	3400	1400	1058	1610
November	2583	543	1000	1035	380	N/A	N/A
December	55	66	100	200	380	634	384

c. Northern (Steller) Sea Lion

In April 1990, the National Oceanic and Atmospheric Administration published an emergency rule, listing the Northern sea lion as federally threatened due to a precipitous decline throughout its range. From the 1920s through 1940, approximately 700 Northern sea lions resided on the South Farallon Islands. By the late 1960s, numbers had been reduced to about 200 (110-125 breeding females) and these numbers remained stable until the early 1980s. Numbers have since declined steadily to about 50 breeding females (Section G.9). This population has recently exhibited a low pregnancy rate and high incidence of premature pupping (stillborn), resulting in minimal to nonexistent reproduction. Reasons for the decline may be many, including competition for food with humans, pollution, and human disturbance. With such low reproduction, the status of the Northern sea lions at Farallon NWR remains precarious. Increasing human disturbance to Northern sea lions and seabirds of the Farallon Islands led to a Service proposal to limit vessel traffic around the Refuge (Section G.11). The emergency listing included interim measures providing for closures to vessel traffic around rookeries, but these were restricted to Alaska.

3. Waterfowl

A pair of oldsquaw were seen on February 10-20, the first since 1981. A rare sighting of a black scoter was reported on March 7-8. The fifth island record of blue-winged teal occurred on October 5 when two were seen.

4. Marsh and Water Birds

At least eight Pacific loons were observed in late August around the islands. A sora was reported on March 28, the second spring record (first record was May 26, 1970).

5. Shorebirds, Gulls, Terns and Allied Species

Farallon NWR is an extremely important breeding site for seabirds. It supports 29% of the breeding seabird population in California and is the single largest seabird colony in the contiguous United States. Large segments of the state's breeding seabird populations use these islands for nesting including ashy storm-petrels, Brandt's cormorants, western gulls, tufted puffins, rhinoceros auklets, and Cassin's auklets. Seabird populations and productivity were monitored by PRBO by cooperative agreement. A summary of breeding population numbers and reproductive success is presented in Table 2.

The Brandt's cormorant population size was considerably smaller than that of 1989, likely due to fewer birds breeding. Pelagic cormorants mostly did not attempt breeding, accounting for a breeding population of 0. Double-crested cormorant numbers dropped, following steady increases in recent years. Some individuals may have moved to coastal breeding locations. PRBO detected several double-crested cormorants banded at the Farallons at a colony in San Francisco Bay in 1990.

TABLE 2
Southeast Farallon Breeding Seabird Populations

	1987		1988		1989		1990	
SPECIES ¹	BP	YF	BP	YF	BP	YF	BP	YF
Ashy storm-petrel ²	4,000	-	2,000	70	2,000	NA	1726 ⁴	NA
Double-crested cormorant	350	-	400	-	620	394	468	NA
Brandt's cormorant ²	10,266	9,239	10,000	8,250	10,967	7,732	6564	2691
Pelagic cormorant	760	950	800	552	30	15	0	0
Black oystercatcher	40	7	40	26	30	15	30	12
Western gull ²	21,864	10,230	20,820	16,656	21,883	14,662	20,278	8213
Pigeon guillemot	1,100	770	2,000	910	1,867	448	960	120
Common murre	34,400	15,480	31,708	14,111	41,167	17,290	42,268	17,119
Cassin's auklet	135,000	47,250	100,000	38,800	NA	0.65 ³	NA	0.48 ³
Rhinoceros auklet	330	-	400	164	500	195	800	59

* BP=Breeding population; YF=Number of young fledged

- (1) Data for Leach's storm-petrel and tufted puffin are not available, due to small population sizes and inaccessibility. Blanks indicate insufficient data.
- (2) Farallon National Wildlife Refuge contains the largest breeding colony in the world for these species.
- (3) Chicks fledged per pair
- (4) Numbers are likely higher

Western gull population size decreased slightly. Although habitat appears to be saturated, some new territories were established in peripheral areas. The population will likely become limited by space within the next few years. Numbers may have been somewhat affected by a severe botulism outbreak in 1990 (Section G.17). A rare electrical storm also resulted in some gull mortality. On January 13 at 0230, an electrical storm caused at least two lightning strikes. The next morning, PRBO biologists found dead and injured gulls on SEFI and West End. An estimated 50 were killed and another 50 injured (mostly broken wings). It appeared that birds flushed and may have been temporarily blinded by the lightning, resulting in collisions with cliffs and each other.

The common murre population peaked at over 102,000 in 1982, followed by a steady decline. This decline was due to the combined effects of gill-net caused mortality, the 1983 ENSO event, and oil spills. The nearshore gill-net fishery was halted in late 1987, due to its significant impact on seabirds (primarily murre) and marine mammals. Due to lag effects (murre breed at 4-6 years of age), recovery is expected to take several years.

In 1989, refuge staff conducted aerial surveys of the murre population at the Farallon Islands and at all 16 other murre colonies in central and northern California. Results will be part of a report, "Breeding populations of seabirds in central and northern California" which will be completed in 1991 (Section D.5). Common murre populations were estimated at 40,860 at the South Farallons based on these aerial photographic surveys. A breeding population of 27,308 murre was estimated at the North Farallons. Aerial surveys were repeated on May 29, 1990 at Farallon NWR. Photographs were archived until funds and staffing will allow them to be counted. PRBO ground counts produced an estimate of 42,268 breeding murre at the South Farallon Islands in 1990.

Pigeon guillemot populations dropped to 960, half of the 1989 breeding population size. This decrease was undoubtedly due to low food availability and poor breeding conditions.

Cassin's auklet populations are not estimated on an annual basis due to the difficulty in surveying these burrow and crevice nesters. However, the 1989 survey effort by USFWS (Section D.5) produced an estimate of 38,274 breeding birds using a detailed count of burrows and crevices at the end of the breeding season. This estimate was much lower than the 1971 estimate by Manual (1972, 1974) of 105,492 breeding birds. The much lower estimate in 1989 appears to be at least partly due to more accurate survey methods. However, declines are also suspected, possibly due to a decline in suitable burrow sites, predation by western gulls, changes in prey availability, and oil spill mortality. More study is needed on this important Cassin's auklet colony.

Seabird breeding activities on the Farallon Islands are correlated with the seasonal occurrence of oceanic upwelling off central California. Extended periods of strong northwesterly winds during late winter and early spring promote the upwelling of cold, nutrient-rich subsurface waters. Upwelling stimulates phytoplankton blooms and the production of zooplankton and juvenile rockfish, which are the prey-base for the seabirds of the refuge. The 1990

breeding season was preceded by low ocean productivity during the latter half of 1989.

The 1990 seabird breeding season was one of the worst compared to previous years (1971 - 1989). Breeding success was extremely poor for western gulls, Brandt's cormorants, pelagic cormorants, and pigeon guillemots. Early signs during the late winter and early spring indicated low food availability for northern Pacific seabirds. In February, many dead and starving rhinoceros auklets were observed on and around the islands, as well as on mainland beaches. Horned puffins, northern fulmars, black-legged kittiwakes, and fork-tailed storm-petrels were unusually common and many were found dead along the coast. Cassin's auklets exhibited asynchronous egg laying, the first time since 1979. In addition, a late storm dumped two inches of rain on May 27-28, flooding many Cassin's auklet and western gull nests, as well as a few pigeon guillemot and rhinoceros auklet crevices.

Reproductive success for Brandt's cormorants was below average. Many nests were abandoned and starving chicks were common in the colony. Approximately 50% of all eggs failed and 40% of all chicks failed to fledge. Pelagic cormorants failed to breed. A few built nests but no eggs were laid. This followed a poor year in 1989, when complete reproductive failure occurred.

Approximately 30% of western gull eggs failed to hatch and 60% of the chicks failed to fledge. Intraspecific predation was prevalent in response to low fish availability. Common murre did not fare as poorly, although reproductive success was slightly below average. Twelve percent of eggs failed to hatch and 7% of chicks failed to fledge. Success by early breeders was reduced by the May storm.

Pigeon guillemot egg laying was unusually prolonged. Many nests were abandoned and chick starvation was common. About 40% of eggs failed to hatch and 70% of the chicks did not fledge. Cassin's auklet reproductive success was well below average and little or no double brooding occurred. Almost 40% of all eggs and 30% of all chicks failed. Similarly, 30% of rhinoceros auklet eggs failed to hatch, and 40% of all chicks failed to fledge.

As in 1989, the poor 1990 season cannot be attributed to an El Nino Southern Oscillation. Sea surface temperatures were cool and upwelling was strong. Apparently, rockfish spawned but the young did not survive, resulting in a reduction of this important food source. The percent of rockfish in the diet of common murre and pigeon guillemot chicks was well below average. Krill resources also must have been reduced, evidenced by the relatively poor breeding success of Cassin's auklets.

As in past years, oiled birds were regularly seen throughout the year. Large numbers were recorded in February, including 175 common murre, three western gulls, and a black-legged kittiwake. This oiling may have been associated with increased leaking from the sunken Puerto Rican tanker during winter storms.

Many uncommon seabird species were reported in unusual numbers in 1990. Hundreds of northern fulmars were regularly seen in February and March. An island high of four horned puffin's occurred in March. As many as 40 fork-tailed storm-petrels were observed in February, the largest numbers since 1977. The third summer record of an ancient murrelet was reported in August. Unprecedented numbers of black-vented shearwaters were recorded in the fall, including an island high of 60 in September. Black storm-petrels (1-3) were seen in late August and late September, the only records other than sightings in 1983. A rare Murphy's petrel was observed on September 27 and the second island record of a long-tailed jaeger was reported the week before. An unprecedented invasion of several thousand California gulls occurred on October 17-21, probably in response to a run of small herring in the area.

6. Raptors

Between 2-4 burrowing owls were present throughout the fall and winter months. Numbers peaked at 10 in early winter. Other sightings of interest included an osprey on April 16, a long-eared owl on August 12-13, and a black-shouldered kite on October 24 (11th island record).

7. Other Migratory Birds

Southeast Farallon Island is a place well known among ornithologists, ecologists, bird watchers and others, for the number and diversity of land and freshwater birds that show up on the island. Many of these birds are common western birds migrating either north or south depending on the time of year, while others are common western birds that are not strongly migratory (e.g., northern mockingbird, western meadowlark). The birds that attract the most attention are the eastern vagrants common elsewhere in the country but not normally found on the west coast or in California. On rare occasions, birds from other continents appear on the island such as red-footed booby, dotterel, dusky warbler, and brown shrike.

In the case of eastern vagrant birds, the majority of them appearing on the island are juvenile young-of-the-year birds. PRBO biologists are currently theorizing that these birds were born with physical or chemical defects causing them to incorrectly migrate east to west rather than north to south. If this is true, the intense banding effort will not directly aid in shedding light on this theory since the birds would be flying further out to sea and dying after departing the island.

This year was not a particularly good year for landbirds, in part due to fall weather that alternated between clear skies and heavy fog, neither of which is conducive to landbird waves. Records of interest included two western flycatchers in late March, a red-breasted sapsucker on February 18 (the first winter record), and on June 14 a red-eyed vireo, black-throated green warbler, American redstart, clay-colored sparrow, and vesper sparrow. A wave of landbirds in mid-April brought at least 20 white-crowned sparrows, 20 yellow-rumped warblers, a Nashville warbler, Townsend's warbler, warbling vireo, several hooded orioles, and 10-15 Brewer's blackbirds. On October 18, a yellow-bellied sapsucker visited the islands, a first record for this species.

9. Marine Mammals

Maximum populations and breeding success for the five pinniped species using Southeast Farallon Island during the last seven years are shown in Table 3. California sea lion numbers peaked at very low numbers for the fifth consecutive year at just below 2,000. The majority of these animals consisted of immature individuals. Along the California coast, the majority of California sea lion young are produced south of Point Conception with the Farallons representing the northern breeding limit for this species. As in 1988, no pups were known to be produced this year. Numbers remained lower than normal through the year.

In contrast to the California sea lion, the Farallons are near the southern breeding limit of the Northern sea lion, which pups as far south as southern California. Breeding colonies of this species at the Farallons and further south have all been declining. Populations peaked at 205, up from the low level of 140 observed in 1988 (Section G.2). However, numbers of breeding females remained depressed, compared to 110-125 through the early 1980's. Animals continued to move from the more protected coves of Southeast Farallon Island to the more remote Shell Beach area on West End. This movement appears to be directly related to disturbance from diving activity and first started in 1987, doubling each year thereafter (Section G.11). Some of this activity occurred in close proximity to the Northern sea lion breeding and haul out sites. Their more remote location made it difficult to monitor reproductive success. The first pup was seen on June 5 on Shell Beach. A total of five pups were observed, more than had been seen in recent years. However, this may be due to increased monitoring effort and the use of a Questar telescope.

It is estimated that over 400,000 northern fur seals used the Farallons during the breeding season prior to the arrival of east coast and Russian sealers in the 1800s. This species was subsequently extirpated from the Farallons and today, northern fur seal use only occurs at very low levels and does not include any breeding. Numbers peaked at four in September, including a bull that has appeared in previous years. This species may someday return as a breeding species since many animals occur nearby at the 100 fathom curve.

Elephant seals were also eliminated from the Farallons, but recolonized the island in the early 1970s. They have been breeding here for over 15 years. More recently, major breeding activity has shifted from the Sand Flat on Southeast Farallon to the larger Shell Beach on West End. Many younger females have moved to West End while Sand Flat females were older, age 7-16 years. By February, approximately 387 cows pupped and 262 pups were weaned. Pup survival (76%) was similar to last year. As usual, pup mortality was caused mostly by crushing (21%) or washing away (30%). Pup mortality was high in January due to high surf and tides. Nineteen of 25 pups were lost at North Landing and 10 of 16 at Garbage Gulch. A rare birth of twins was recorded on Sand Flat in January, the first such case in several years on the islands.

The early 1990-91 elephant seal breeding season indicated lower numbers of cows and pups compared to recent years. Similar decreases were reported from Ano Nuevo State Park, a large colony north of Santa Cruz. The first pregnant

cows arrived on December 16 at Mirounga Beach. The first pup was born on December 20 at Shell Beach.

As the breeding population continued to shift to West End Island, human activity increased in order to maintain research and monitoring efforts. However, this Wilderness Area was intended to provide an undisturbed haven for wildlife at the South Farallon Islands. While all activities were conducted with as little disturbance as possible, impact on common murres, elephant seals, and habitat also increased. For example, the presence of researchers sometimes resulted in flushing murres attending their breeding sites in winter, from Maintop, Phil's Hill, and other West End colonies. Refuge staff developed stricter protocol with PRBO staff to limit numbers of visits and people to that part of the Refuge. Several disturbances to murres were recorded in the 1989-90 elephant seal season. Refuge staff and PRBO agreed to phase out the study over a five-year period beginning in the 1988-89 season and to adopt increasingly stringent guidelines in order to minimize disturbance.

Elephant seals are tagged with two numbered pink plastic tags on the hind flippers. These animals can then be identified on the Refuge and at other sites in California. Farallon-born elephant seals have been observed at haulouts on San Nicholas Island, San Miguel Island, Ano Nuevo and Castle Rock NWR in California and in 1985 for the first time, a Farallon-born yearling was observed on Isla San Martin, Baja Mexico.

Pinnipeds with neck constrictions were regularly seen. For example, as many as 14 "ring-necked" California sea lions were observed in May. Materials involved included packing straps and monofilament from gill nets. Constrictions were removed using a destrapping tool whenever the animal was accessible. Several animals were also observed with salmon flashers and hooks attached to their mouths throughout the year.

Table 3

MAXIMUM POPULATION NUMBERS (PEAK MONTH)

	1984	1985	1986	1987	1988	1989	1990
Calif. Sea Lion	6783 (Jul)	4187 (Apr)	2478 (Mar)	2664 (May)	2639 (Apr)	1994 (Apr)	1949 (Aug)
Northern Sea Lion	208 (Dec)	291 (Nov)	219 (Nov)	191 (Jun)	140 (Oct)	186 (Oct)	205 (Jul)
Harbor Seal	62 (Feb)	55 (Nov)	75 (Nov)	64 (Jul)	71 (Aug)	83 (Jun)	85 (Feb)
No. Elephant Seal	824 (Jan)	763 (Jan)	810 (Jan)	845 (Apr)	779 (May)	722 (Oct)	863 (Apr)
No. Fur Seal	1 (Oct)	2 (Apr)	8 (Sept)	3 (Sept)	4 (Sept)	2 (Aug)	4 (Sept)

NUMBER OF PUPS BORN/NUMBER OF PUPS WEANED

	1984	1985	1986	1987	1988	1989	1990
Calif. Sea Lion	1/1	0/0	0/0	0/0	0/0	0/0	0/0
Northern Sea Lion	8/6	5/4	4/2	7/5	NA/NA	NA/NA	5/NA
No. Elephant Seal	437/302	435/279	430/278	425/315	NA/260	387/295	NA/262
No. Fur Seal	Historic Breeder - No Recent Records						

Gray whales were commonly observed migrating during winter months. Blue whale sightings have increased during the mid-1980s. Small numbers of humpback whales were reported in most months of the year. Other species observed included minke, fin, and sperm whales, and Risso's and Dall's dolphins. A sighting of 10 orcas, including one albino, was reported 4.5 miles southeast of the Refuge on May 27.

11. Fisheries Resources

Great white sharks were once considered very rare along the California coastline, however, in the 1980s shark sightings, captures by commercial fishermen, and shark bites to humans have all increased. The main reason for the apparent great white population increase is the tremendous increase in their prey base: elephant seals and sea lions. The commonplace occurrence of great whites around the Farallons has virtually eliminated the once popular sport of scuba diving.

In 1982 a local commercial fisherman captured and killed 4 great whites in one day near SEFI. Subsequently, very few observations of feeding sharks were made in all of 1983 strongly suggesting that the sharks killed had made up a local population in the vicinity of the Refuge. During 1984 an increasing number of "feeding events" were witnessed thus leading us to believe that the local population theory is correct and that the population around the Refuge is increasing. This trend has continued. A study on sharks in waters around Southeast Farallon Island monitored shark attacks during the fall. Observers monitored surrounding waters from the Refuge and recorded shark attacks, prey identification, location, and took photo and video documentation. Some individual sharks could be identified by their appearance and scar pattern. The incidence of attacks peaked in October, when 28 were recorded, including 19 on elephant seals and one on a California sea lion.

In September, two boats fished unsuccessfully for great white sharks around the Southeast Farallon Island. There is increasing worldwide concern regarding overharvest of this unique predator. Increased shark fishing pressures could severely impact white shark populations around the Refuge.

Since 1986, commercial abalone and urchin harvesting activity has increased by more than ten-fold in waters surrounding the Refuge. Disturbance to wildlife has correspondingly increased. In 1989, 15 wildlife disturbance events were recorded (mostly involving common murre and pinnipeds) compared to just one each in 1986 and 1987. In 1989, 80% of all disturbance events were caused by abalone and urchin boats.

Many sea lions have abandoned their normal haul out and breeding sites, in what appears to be a direct response to this disturbance (Section G.9). Common murre have declined throughout the 1980s and remain extremely sensitive to disturbance. In June 1989, refuge staff proposed a closure to boat traffic (1000 feet) and abalone and urchin diving (one mile) around the Farallon Islands. This proposal was discussed at a public meeting during which much opposition was expressed.

During January through April 1990, although abalone and urchin boat days decreased from 1989, wildlife disturbance increased. In just those four months, 13 disturbance events were observed by PRBO biologists. The increased frequency of disturbance appeared to heighten the sensitivity of common murre and pinnipeds. For example, in April 1990 with egg laying imminent, a passing sailboat flushed an entire colony of 2000+ murre.

In June 1990, we sent a formal proposal to the California Department of Fish and Game (DFG) requesting year-round boating restrictions around the Farallon Islands. Two meetings were held in October and December with all affected user groups including fishermen, commercial divers, recreational and tour groups, PRBO, DFG, the National Marine Sanctuary, and Refuge staff. A compromise proposal was agreed upon by all groups at the December meeting. It included:

1. Establishing a State Ecological Reserve within one mile of the shoreline except for Middle Farallons.
2. Speed limit of five nautical mph within 1000 feet of shoreline.
3. Exhaust systems on engines and compressors to terminate below the waterline on abalone and urchin vessels.
4. No vessel shall operate within 300 feet of the North Farallons and portions of the South Farallons from March 15 through August 15.
5. Emergency anchorage and operations allowed.

This proposal will be presented to the DFG Commission for passage in early 1991.

16. Marking and Banding

Banding and color marking seabirds, land birds and elephant seals are conducted on a large scale by Point Reyes Bird Observatory. Since 1971, western gulls and all three species of cormorants have been banded with Service and color bands. Common murre are also banded late in the season at two locations. Many of the color bands are numbered or lettered, therefore, some birds have been followed as nestlings through more than 15 years of life. Valuable information is being obtained in the breeding success of known age birds, and in relation to adverse environmental conditions and other factors.

H. Public Use

17. Law Enforcement

A minimum of 14 aircraft-caused disturbances were recorded in 1990. They involved a variety of aircraft types including Coast Guard helicopters, military aircraft (jets, helicopters, and carriers), and private single and twin-engine aircraft. Most overflights resulted in disturbance to hundreds and sometimes thousands of common murre that were flushed from the islands.

We attempted to contact any parties that could be identified to educate them regarding the sensitivity of the Refuge, regulations, and the need to avoid such disturbance. However, this appears to be a growing problem and the involved party often cannot be identified.

In addition, the first trespass case in over a year was observed in August, when a snorkeler came out on the rocks while collecting abalone. Although the boat identification number was obtained and rechecked, it came up as unknown. We suspect that the boat numbers may have been altered.

This incident occurred within days following the publication of an article that was printed in the July/August issue of the California Department of Fish and Game magazine, Outdoor California. Titled "Kayaking the Farallons," it described how large numbers of California sea lions and a Steller sea lion bull were flushed into the water so that the author could obtain close views. The article was published during the height of our attempts to gain boat restrictions around the Farallons to reduce disturbance (Section G.11). Regional Director, Marvin Plenert, sent a letter that was published in the next issue, asking that the Department help to convey the message that the "tread lightly" philosophy applies to boaters too, particularly in as sensitive and unique an area as the Farallon Islands.

I. EQUIPMENT AND FACILITIES

2. Rehabilitation

Although the boom, which was replaced on contract in 1988, is in excellent condition, various problems continued with hooks and shackles. Shackles were beginning to rust and show wear. In March an attempt was made to replace the main hook which was declared potentially defective by the contractor. However, it was frozen on and could not be removed.

In September, the blue block of the boom began to stiffen up so that with light loads the cable played out on the ground in front of the winch house instead of coming down. All points on the up/down cable were greased which at least partially freed it up.

In March, maintenance worker Steve Lewis successfully hoisted and secured the old North Landing boom. This huge timber was slowly sagging and threatened to crush the North Landing building. He used a 5/8" cable to secure the boom in place and a 4"x4" beam for extra support.

3. Major Maintenance

The generators were regularly serviced and ran well through the year. In March a load bank (giant heater) was installed onto the lines from the generators which automatically puts a load on the generator when all three legs fall below 10 amps. This modification, plus the lower calibrated amp meters installed last year, should help to maintain the proper load, thereby extending the life of each generator.

Repairs to the 100 year old house included interior painting of some rooms, overhauling the front door and resealing the sill and replacing roof shingles as needed.

The Mariner outboard engine was taken off the island in September for repairs (it was running on one cylinder) but it was not repairable. The seabird research group, at Northern Prairie Field Research Station - Dixon, loaned us a 15 hsp Mariner engine until a replacement can be purchased in 1991.

4. Equipment Utilization and Replacement

We have been gradually replacing appliances on the Refuge. In 1989, new appliances were purchased for the FWS house, including a dryer, refrigerator, and stove for \$1,600. In December 1990, a new refrigerator was purchased to replace an old, nonfunctional one.

5. Communications System

In January, installation of the new radio system was completed by PRBO and their contractors. This UHF/VHF system included antennas at the lighthouse and FWS house, a UHF base station and marine radio at the lighthouse, and a phone/radio in the house. It was funded by FWS and private funds and donated labor.

7. Other

Although the U.S. Coast Guard had indicated that they would greatly reduce their efforts on the island, they continued to do some repairs and clean-up. The following is a list of some of their accomplishments.

Water and Fuel

Water and/or fuel were delivered to the island four times during the year by the cutter "Blackhaw." In February, PRBO staff discovered a diesel leak originating from a fuel line from the Coast Guard generator. Approximately 30-50 gallons spilled out onto the terrace. PRBO staff stopped the leak and the Coast Guard immediately flew out to make repairs and clean up the spill. The overflow float had gotten stuck, causing the leak. The similar FWS system was checked over and appeared functional.

Light

A lighting strike on January 13 (see Section G.5) apparently caused extensive damage to the light. It failed four times in January. Each time PRBO staff reported the failure to the Coast Guard. The monitoring system on the mainland was not working due to a battery failure. The Coast Guard made many trips to repair this important aid to navigation.

J. OTHER ITEMS

3. Credits

All sections were written by Jean Takekawa. Typing was accomplished by Joan Dawson.

SAN PABLO BAY NATIONAL WILDLIFE REFUGE
Sonoma and Solano Counties, California

ANNUAL NARRATIVE REPORT
Calendar Year 1990

U.S. Department of the Interior
U.S. Fish and Wildlife Service
NATIONAL WILDLIFE REFUGE SYSTEM

INTRODUCTION

San Pablo Bay National Wildlife Refuge was established in 1974 to protect bay wetlands for endangered species, waterfowl and shorebirds. This refuge consists of approximately 11,700 acres along the north shore of San Pablo Bay in Sonoma and Solano Counties, California, between the Petaluma and Napa Rivers. Habitat types are made up largely of open water, mudflats, and salt marshes.

Almost 95% of San Pablo Bay's tidal marshes have been leveed or filled. The remaining wetland habitats support abundant fish and wildlife species. It provides major wintering habitat for shorebirds and waterfowl, particularly diving ducks. Major developments in the bay system such as hydraulic mining, diking and filling of marshes, water diversions, and agricultural and industrial uses have all had tremendous impacts on the Bay ecosystem.

Lower Tubbs Island was donated to the refuge by The Nature Conservancy after the area was acquired in 1969 to prevent the area from being converted into an oil storage depot. As a condition of the donation, Lower Tubbs Island is closed to hunting, however, wildlife observation is allowed for people willing to hike into the area.

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K. FEEDBACK

A. HIGHLIGHTS

--Mosquito Districts from Marin/Sonoma and Solano Counties requested assistance from refuge staff on issues involving management of mosquitoes on the refuge (Section F.10).

--Cullinan Ranch acquisition and development planning was addressed throughout the year (Section C.1).

--The Fish and Wildlife Service was asked to be the managing agency for the recently acquired Leonard Ranch (Sonoma Baylands) by the California State Coastal Conservancy. (Section C.1).

--Laguna de Santa Rosa acquisition issues were addressed throughout the year (Section C.1).

--A Challenge Grant proposal to restore tidal flow to Tolay Creek was presented to the California State Coastal Conservancy and California Department of Fish and Game (Section J.1).

B. CLIMATIC CONDITIONS

The climate is a Mediterranean type with cool wet winters and warm dry summers. Average annual rainfall is approximately 20 inches. Mean average temperature is 62 degrees F. Precipitation was below normal during 1989 marking the fifth year of drought. Lack of rainfall doesn't greatly impact this Refuge since all wetlands are tidally influenced.

C. LAND ACQUISITION

1. Fee Title

Cullinan Ranch acquisition negotiations continued with lawyers who represented the owners. A sale price was agreed upon, but contingencies, including a contaminant evaluation and an easement with the Federal Aviation Administration for a radio transmitter station, held up the property sale. Realty personnel from the Regional Office are confident that the sale will happen soon.

The Corps of Engineers hosted a meeting to discuss the feasibility of raising the ground elevation of Cullinan Ranch with dredge material to restore it to tidal salt marsh conditions. The Service is interested in this restoration option, but needs to get concurrence from Regional Office Engineering.



Cullinan Ranch is the light colored area and centered in the photograph. Oat hay is grown on this property, resulting in the current brown appearance. However, the Service is anxious to acquire title and begin restoration to tidal salt marsh.

The California Coastal Conservancy acquired a 632-acre parcel of land adjacent to the west end of San Pablo Bay NWR, and near the mouth of Petaluma River. The Service has been asked to be the managing agency for this area called Sonoma Baylands after it is restored to tidal marsh. The Preliminary Project Proposal for this area and a tidal marsh portion of Mare Island Naval Shipyard was prepared and approved in 1990. The Service will continue participating in restoration and development plans for Sonoma Baylands, not only for the guidance that can be provided, but also to monitor the success of the dredge material deposition process that may also be used at Cullinan Ranch.

Marin Islands, located in San Pablo Bay, have been identified as unique habitat worthy of protection due to the sanctuary they provide birds, especially a heron and egret rookery. The Coastal Conservancy originally identified this acquisition priority but in 1990 the Trust For Public Lands took the lead on acquisition and requested funds from various interests including: U.S. Fish and Wildlife Service-\$1,000,000; California Department of Fish and Game-\$500,000; Marin Open Space District-\$600,000; State Lands Commission-\$600,000; Trust For Public Lands-\$500,000 (local private donations). The total price was renegotiated to a lower price (\$3.2 million) because the owners, Crowley Maritime, want this area protected for wildlife.

An Environmental Assessment was prepared and a Public Notice issued, but no negative public concerns were raised.

The proposed Laguna de Santa Rosa refuge near Sebastopol was a hot issue through 1990. Congressman Bosco was requesting funds even though Service personnel specified that this area was not a high priority acquisition. Information provided by local residents of the Sebastopol area suggested that this area would be used for storage of excess sewage treatment effluent during periods when minimal amounts could be discharged into the Russian River. Congressman Bosco was not re-elected during the 1990 election and the issue apparently died.

D. PLANNING

3. Public Participation

Refuge staff participated in planning for interpretive and education facilities in the Vallejo area. Various educators and representatives of resource agencies and organizations are attempting to develop an interpretive program, possibly adjacent to Cullinan Ranch. A cooperative venture of this sort may be very beneficial to all cooperators; the Service could concentrate on habitat management in this area and educators could focus on the interpretive program.

5. Research and Investigations

Navy personnel from Mare Island Shipyard completed their second year of data collection quantifying incidence of bird strikes on the powerline adjacent to Highway 37. Their analysis of preliminary results suggests no significant mortality; however, the Service's interpretation of these results indicates significant take, and it is anticipated the mortality will increase tremendously once Cullinan Ranch is restored to tidal saltmarsh habitat. Refuge staff have reiterated these concerns and feel that the best option is removal of the power lines.

E. ADMINISTRATION

1. Personnel

San Pablo Bay NWR is administered as a satellite refuge of San Francisco Bay NWR. As such no personnel are stationed permanently at this site.

8. Other Items

A revenue sharing payment in the amount of \$4643.00 was presented to Sonoma (\$2324.00) and Solano (\$2319.00) Counties during 1990.

F. HABITAT MANAGEMENT

2. Wetlands

Tide gates and water control structures were experimentally manipulated to increase tidal flow into some units of Lower Tubbs Island. A water management regime has been established to provide regular tidal flow, but periods of low tidal variation during summer months can result in heavy algae blooms in areas with restricted tidal flow.

5. Grasslands

The 80-acre parcel of grassland habitat in Tubbs Island, adjacent to Lower Tubbs Island, was evaluated for diking and restoration to salt marsh habitat. Ducks Unlimited has expressed an interest in assisting with restoration of this area, and the Service will submit a proposal requesting financial assistance.

10. Pest Control

Marin/Sonoma Mosquito Abatement personnel used B.T.I. to control mosquitoes on Lower Tubbs Island on several occasions. They also opened some channels with a spritz ditcher to allow tidal flow into stagnant water pockets that harbored breeding mosquitos.

G. WILDLIFE

2. Endangered and/or Threatened Species

The salt marsh harvest mouse and California clapper rail are resident endangered species on the refuge. Studies on adjacent Navy lands by Navy biologist Steve Kovach, on Mare Island indicate the salt marsh harvest mouse populations are high. California clapper rail numbers have not been quantified in recent years. The lack of channels in the pickleweed marsh probably limits the suitability of the refuge for this species.

3. Waterfowl

The annual mid-winter waterfowl survey was conducted on January 2 and 3, 1990 by personnel from the Northern Prairie Wildlife Research Center field office in Dixon. Total ducks counted in the North Bay and North Bay Salt Ponds was 99,723 and 22,081, respectively. These numbers are listed by species in Table 1 along with numbers from 1989. There were significant increases in the number of scaup using the north bay in 1990.

San Pablo Bay and adjacent salt ponds provide one of the most important wintering areas along the Pacific Flyway for canvasbacks. Concentrations were especially impressive in the salt ponds that are controlled by Leslie Salt Company. Any alterations of these ponds could greatly impact diving duck use in general.

4. Marsh and Water Birds

The black rail is a candidate species that is more common in San Pablo Bay than elsewhere in the San Francisco Bay area. One was seen by the assistant manager satellites and a police officer while re-posting the boundary of Lower Tubbs Island. No formal surveys are conducted on this Refuge for these species, but incidental observations are encouraging.

5. Shorebirds, Gulls, Terns, and Allied Species

San Pablo Bay NWR is a stronghold for shorebirds in the north Bay area. Average numbers during migratory periods and winter months are approximately 200,000 birds. Predominant shorebird species include: dunlin, western sandpipers, dowitchers and marbled godwits.

9. Marine Mammals

Harbor seals are relatively common in San Pablo Bay and frequently haul out on Lower Tubbs Island during high tides. It is not known if pupping occurs on the Refuge, but some seals appear to be present throughout the year. Table 1. Numbers of ducks observed during the Mid-winter Waterfowl Surveys conducted January 2 and 3, 1989 and 1990.

Table 1. Numbers of ducks observed during the Mid-winter Waterfowl Surveys conducted January 2 and 3, 1989 and 1990.

Species	North Bay		Bay Salt Ponds	
	<u>1989</u>	<u>1990</u>	<u>1989</u>	<u>1990</u>
Mallard	41		58	81
Gadwall	20	12	279	83
Wigeon	25	93	895	278
G. W. Teal			79	64
B.W. Cinn. Teal	12		8	
Shoveler	105	132	766	2818
Pintail	1732	1560	405	413
Canvasback	1622	7394	14932	10945
Scaups	4419	71688	19862	2046
Goldeneye	2	341	211	325
Bufflehead	115	141	1400	971
Ruddy Duck	111	749	4025	3442
Scoters	4284	17613	18	9
Unidentified	25		1446	606
TOTAL	12,513	99,723	44,396	2,2081

H. PUBLIC USE

1. General

Lower Tubbs Island is open year round during daylight hours. Hunting is allowed on Tolay Creek north of Lower Tubbs Island during the approved waterfowl and pheasant hunting seasons. The quality of wildlife observation on Lower Tubbs Island and the mudflats of San Pablo Bay is very high.

8. Hunting

Waterfowl hunting is allowed on the open water and mud flats on State lease lands. As stipulated in the deed transferring the Lower Tubbs Island unit from the Nature Conservancy, no hunting is allowed on this area.

Pheasant hunting is allowed on State lease lands adjacent to Lower Tubbs Island. Pheasant found on the refuge come from an adjacent commercial hunting club.

17. Law Enforcement

Target shooting on the entrance road to Lower Tubbs Island and illegal trespass with vehicles continues to be a problem. The gate to this entrance road has had the chain cut to allow entry, and unauthorized locks have been placed on it at various times. Apparently, most illegal entry is for the purpose of hunting or target shooting, and partying at the "Troll House" adjacent to Lower Tubbs Island. The "Troll House" is off Refuge property but is considered an attractive nuisance due to its proximity to a prime wetland "sanctuary."

I. EQUIPMENT AND FACILITIES

2. Rehabilitation

Two 48 inch water control structures on the outer levee of Lower Tubbs Island have leaks that limit the capability of stopping flow through these structures when needed. Regional Office engineering staff have recommended patching these leaks from inside the pipes, but the pipes are always inundated at least 75% even during the lowest tides. Repair or replacement will be costly propositions in this location.

3. Major Maintenance

Illegal dumping on the Figueras Tract has been discouraged by Cal Trans placement of a gate and barrier posts that were constructed by Refuge staff. Cal Trans has agreed to assist with trash clean up in this area.

J. OTHER ITEMS

1. Cooperative Programs

Refuge staff proposed a Challenge Grant project to California Department of Fish and Game (DFG) and the Coastal Conservancy regarding tidal flow restoration to Tolay Creek. The Coastal Conservancy was requested to help fund construction (excavation) of the Tolay Creek channel, and CDFG was asked to acquire water control structures to regulate and allow tidal flow to bypass the State-owned pond adjacent to Tolay Creek. All parties agreed that restoration of Tolay Creek to an estuarine system would be a very beneficial wetland project.

3. Credits

This report was prepared by Dick Munoz. Typing was accomplished by Jan Armigo Brown.

ELLICOTT SLOUGH NATIONAL WILDLIFE REFUGE

Santa Cruz County

ANNUAL NARRATIVE REPORT

Calendar Year 1990

U.S. Department of the Interior
Fish and Wildlife Service
NATIONAL WILDLIFE REFUGE SYSTEM

INTRODUCTION

Ellicott Slough National Wildlife Refuge was established in 1975 for the protection of the endangered Santa Cruz long-toed salamander. Of the six known locations where this species can still be found, the refuge supports the largest remaining population. Management objectives are to protect the site from human disturbance and maintain habitat quality.

The refuge consists of 128 acres of upland oak woodland and willow thickets. It is located in Santa Cruz County, 0.5 mile inland from Monterey Bay and 4 miles west of Watsonville on San Andreas Road. Combined with the adjacent 30 acres of State land, the area is managed in cooperation with the California Department of Fish and Game. The salamander breeds in the vernal pool on State land in the winter and spends the remainder of the year in the valley and hillside habitat on Service land. These lands were acquired to protect them from a proposed trailer park development.

Ellicott Slough National Wildlife Refuge is closed to the public in order to protect salamander habitat from disturbance.

The Santa Cruz long-toed salamander grows to about 5 inches in length and has relatively long, tapered toes. It is shiny black, with an irregular pattern of metallic orange to yellow gold blotches along the back. Adults spend most of their life under leaf litter or in animal burrows feeding on beetles, centipedes, earthworms, isopods and spiders.

Eggs are deposited in the vernal pool during the rainy season. They hatch in one week and develop into adults in about three months. Metamorphosis occurs after larvae reach 1-1/4 inches in length. As the vernal pool dries, salamanders migrate back to nearby woodlands.

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K. FEEDBACK

A. HIGHLIGHTS

--Vernal pond did not hold enough water to support salamander reproduction for the fourth straight year (Section F.2).

--Preliminary plans were made to construct a vernal pond on Refuge property using donated equipment and labor (Section F.2).

B. CLIMATIC CONDITIONS

This is the fifth consecutive drought year with no vernal ponding to provide salamander breeding habitat. Refuge staff are concerned that lack of reproduction may severely impact the population of Santa Cruz long-toed salamanders. The light rains that occurred in 1990 soaked into the ground immediately and appeared to be marginally adequate to maintain perennial vegetation.

D. PLANNING

4. Compliance With Environmental Mandates

Refuge staff visited Ellicott Slough NWR with Enhancement personnel from the Ventura office to discuss drought impacts and the possibility of constructing a pond for salamander breeding. Supplemental pumping of well water was discussed as were plans to continue the exotic vegetation eradication program.

E. ADMINISTRATION

1. Personnel

Ellicott Slough is administered as a subunit of San Francisco Bay National Wildlife Refuge Complex. As such, no personnel are stationed full time at this site.

4. Volunteer Program

A neighboring landowner expressed interest and concern for the salamanders, and indicated that she would be happy to monitor adjacent private lands in the event of heavy soaking rains. She also mentioned that she would be happy to keep Refuge staff informed of moisture conditions during rainy periods.

8. Other Items

A revenue sharing payment in the amount of \$5,168.00 was made to Santa Cruz County during 1990. This payment represented 78% of the calculated amount of the 1990 revenue sharing payment as authorized by the Revenue Sharing Act, Public Law 95-469.

F. HABITAT MANAGEMENT

2. Wetlands

The winter of 1989-90 was very dry and the vernal pool did not hold enough water for salamander breeding to occur, and another dry winter started through the end of 1990. This marks the fifth straight drought year. Since this species is relatively long-lived, contingencies such as pumping water to the vernal pool should be explored. However, the majority of adult salamanders should be in adjacent uplands, so it isn't known whether this will allow more production or just be more insurance for young survival when natural breeding conditions occur. A submersible pump has been purchased and can be installed after water quality has been tested.

A site on Refuge property has been identified as being suitable for constructing another pond. Tentative plans have been made to excavate a pond using volunteer equipment and labor. Preliminary surveying needs to be done, and it may be necessary to line the pond bottom with an impermeable material such as Bentonite clay to adequately hold water.



The Santa Cruz long-toed salamander is suffering the effects of consecutive drought years. Hopefully a new pond and reliable water supply will enable this species to repopulate. (SB)

10. Pest Control

The refuge staff did not have the equipment or opportunity to continue eradication efforts of exotic pampas grass and ice plant. The objective of this work is to maintain the natural plant community to which the salamander is adapted, and the pampas grass is re-establishing itself so rapidly that a major effort must be made over consecutive years to control it.

Exotic eucalyptus is well established and widespread throughout much of the Refuge. A feasible and effective eradication program has not been discovered, but there are concerns that eucalyptus leaf toxins could prevent plant diversity without providing habitat requirements needed by the endangered salamanders.



Exotic eucalyptus trees and pampas grass thrive on disturbed soils of Ellicott Slough NWR. Eradication efforts must be increased to allow native species re-establishment. (SB)

G. WILDLIFE

1. Wildlife Diversity

The refuge provides habitat to various migratory birds, as well as resident birds, small mammals and deer. Excluding the presence of the Santa Cruz long-toed salamander, the habitat of the refuge is not unique for this part of California. However, the refuge is located in an area of intense farming in Santa Cruz County. Many of the surrounding valleys and hillsides are used for greenhouses, farmed for strawberries and raspberries, or grazed by cattle. As more areas are converted to agriculture in the future, the refuge will increase in importance by retaining natural habitat for many species.

2. Endangered Species

The endangered Santa Cruz long-toed salamander presents a management problem in that it is difficult to assess the status of its population during drought years. Thus, it has not been possible to survey salamanders for several years. Little or no breeding has occurred during these droughts. If drought conditions continue in 1990, the importance of pond enhancement will greatly increase.

15. Animal Control

Feral hogs have been documented on Ellicott Slough NWR. Although they pose no obvious problems, they could potentially eat significant numbers of salamanders when the amphibians concentrate during breeding periods. There is also a possibility that hogs could be an attractive nuisance by luring hunters or poachers onto this closed area.

H. PUBLIC USE

1. General

Public use is restricted except for small, organized groups led by refuge personnel. There has been little public interest in visiting this area in recent years due to the drought conditions which did not allow salamander breeding.

I. EQUIPMENT AND FACILITIES

2. Rehabilitation

The fence along FWS property was repaired in several areas. Trespass problems occur sporadically and cutting of fences has been part of this activity.

J. Other Items

4. Credits

This report was prepared by Steve Berendzen. Typing was accomplished by Jan Armigo Brown.

SALINAS RIVER WILDLIFE MANAGEMENT AREA

Monterey County

ANNUAL NARRATIVE REPORT

Calendar Year 1990

U.S. Department of the Interior
Fish and Wildlife Service
NATIONAL WILDLIFE REFUGE SYSTEM

INTRODUCTION

Salinas River Wildlife Management Area is located 11 miles north of Monterey at the point where the Salinas River empties into Monterey Bay. The 368 acre area is cooperatively managed with the California Department of Fish and Game, thus it is designated as a wildlife management area. The area provides habitat for large numbers of wading birds, waterfowl, pelicans, gulls and terns. Two endangered species, the California brown pelican and the Smith's blue butterfly, have been documented on this site.

Habitats include: 1) a 45 acre lagoon that receives a mixture of water from rainfall, surf overwash, high water table, and flooding from the Salinas River; 2) a small grassland area between the lagoon and Salinas River which may represent a remnant of the natural coastal grasslands; 3) beach and low dunes which provide feeding and resting areas for shorebirds, including the threatened western snowy plover and, potentially, the endangered California least tern; 4) high dunes, which are characterized by a high abundance of Coastal buckwheat (the host plant for the endangered Smith's blue butterfly), and the Menzies' wallflower, a candidate for inclusion on the endangered plant list and; 5) uplands that formerly were farmed lands but are now reverting to native vegetation.

Even though the lagoon is only 45 acres, its value to waterfowl is magnified by the fact that intense agricultural practices have greatly reduced wetlands in surrounding areas. Salinas lagoon attracts a fair number of wintering waterfowl during normal rainfall years and provides some nesting habitat for gadwalls, mallards and cinnamon teal.

Salinas River WMA is open to the public and activities include hiking, wildlife and wildflower observations, photography, surf fishing, and waterfowl hunting. Those willing to walk from the parking lot to the front beach are rewarded with beautiful scenery and an excellent presentation of native dune vegetation.

The refuge was acquired in 1973 from the U. S. Army and the Coast Guard. Prior to acquisition, the lagoon was used as a duck hunting area for Army officers and as a practice area for the use of amphibious assault vehicles. Army activity and unauthorized off-road vehicle use were greatly impacting this sensitive area. Since the refuge was established, Salinas River WMA has restored itself remarkably well. The act of preserving this valuable habitat alone justifies the existence of this refuge.

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K. FEEDBACK

A. HIGHLIGHTS

- Clean-up of beach and parking area was very successful with volunteer help.
- Snowy plover predation by red fox is greatly reducing nesting success (Section G.5).
- California Department of Fish and Game personnel were informed that the Service was considering revoking the Cooperative Agreement due to limited management being done.
- Monterey County Flood Control District task force meetings on management of the Salinas River lagoon area were attended throughout the year (Section D.3).
- Plans were prepared and a funding proposal was submitted to deter unauthorized off-road vehicle use (Section H.15).

B. CLIMATIC CONDITIONS

Weather conditions on the refuge are greatly impacted by the influence of Monterey Bay. Winters are generally cool and wet while summers are typically warm. This year was again below average in the amount of precipitation. This marks the fifth straight year of drought conditions. Much of this year's rainfall occurred during February with showers through the spring months. The Salinas River Wildlife Management Area dune system is not typically adversely impacted by drought because fog results in condensation on plants, an adaptation that allows for plant survival in the sandy well drained soils. Wetlands around Salinas River probably are affected by the drought in that less freshwater enters the system.

C. LAND ACQUISITION

2. Easements

The entrance road to the refuge has been a problem for many years. Farmers are encroaching on the 40 foot easement with their crops, and poor drainage makes access impossible for standard two-wheel drive vehicles after heavy rains or while crops are being irrigated.

Last year it was decided that an improved entrance road with a fence on both sides would be beneficial to the Refuge as well as the adjacent farmer. However, funds were not available to make road improvements in 1990.

D. PLANNING

2. Management Plan

The California Department of Fish and Game (CDF&G) has been responsible for managing this Wildlife Management Area since 1973 through a Cooperative Agreement with the Service. Very little active management has been done by CDF&G in recent years due to their limited budget, so Refuge staff requested that the Regional Office terminate the Cooperative Agreement and restore management to the Service. The Regional Office notified CDF&G of intentions to terminate the agreement, and directed Refuge staff to prepare a hunt plan so Salinas WMA could be hunted as a refuge under Service management in 1991.

A hunt plan was drafted and sent to the Regional Office for review late in the year with anticipated completion by the February 1, 1991 due date for the Federal Register.

3. Public Participation

The Monterey County Flood Control District initiated a task force in 1991 to examine two issues:

1. Breaching activities at the mouth of the Salinas River on the refuge's front beach to address flooding during winter rains, and,
2. Water management throughout the year and the effect of this management on the overall health of the Salinas river lagoon ecosystem.

In the past, breaching was sometimes completed unnecessarily, or too early, so that the river lagoon was drained to very low levels, conditions became hypersaline, and birds nesting on river islands became more vulnerable to mammalian predators. The District formulated guidelines as to when breaching will occur. Breaching will only be undertaken when necessary and the refuge will be notified when this activity takes place. This will enable refuge staff to monitor effects of breaching.

The District also contracted a private consultant to prepare a management plan for the Salinas River lagoon area. The plan will examine the hydrology of the River, explore water management possibilities, and recommend water control structure type at the old Salinas River channel. Refuge personnel have attended several task force meetings and reviewed draft reports throughout the year. In addition to improved water management, the Task Force is planning to restore riparian habitat along the river, improve ruderal upland habitat, and assist with public use problems such as unauthorized off-road vehicle use.

Another group, the Marine Dunes Task Force, is working to preserve the integrity of the Marina dunes located south of Salinas NWR while allowing development of residences and recreational facilities. This task force has had some difficulty coordinating opposing goals and uses of these dunes. Because a portion of the refuge dunes are part of the Marina Dunes ecosystem, staff attended some meetings.

4. Compliance with Environmental Mandates

Refuge staff met with enhancement staff from the Ventura field station to discuss Refuge plans and objectives as they relate to endangered species. Potential impacts from adjacent landowners and incompatible use of off-highway vehicles were also discussed.

5. Research and Investigations

The Salinas River Task Force contracted environmental consulting firms to investigate water management options for lower Salinas River. Wetlands Research Associates were contracted to install monitoring wells and establish monitoring criteria. Four wells were placed on the Refuge, and monitoring was conducted by Monterey County Water Resources personnel. Preliminary results indicate that the high water table has lateral movement as indicated by well salinity changes corresponding to adjacent water bodies.

A study was initiated out of the University of California - Los Angeles Department of Biology entitled, "Population genetics and systematics of the ornate shrew" (Sorex ornatus). Preliminary results of this small mammal trapping study have shown good populations compared with trapping success in all other sites sampled.

E. ADMINISTRATION

1. Personnel

Salinas River Wildlife Management Area is administered as a satellite station of San Francisco Bay NWRC. As such, no personnel are stationed full-time at the site. California Department of Fish and Game manages the site under the terms of a Cooperative Agreement.

4. Volunteer Programs

Refuge volunteers from the San Francisco Bay National Wildlife Refuge assisted Refuge staff in a clean-up effort at Salinas River WMA. Refuse and litter debris was cleaned up along the river and on the beach in addition to fence repairs and sign posting. There are no regular volunteer projects at Salinas River WMA, but volunteers from San Francisco Bay NWR enjoy opportunities to get out with staff to satellite refuges.

8. Other Items

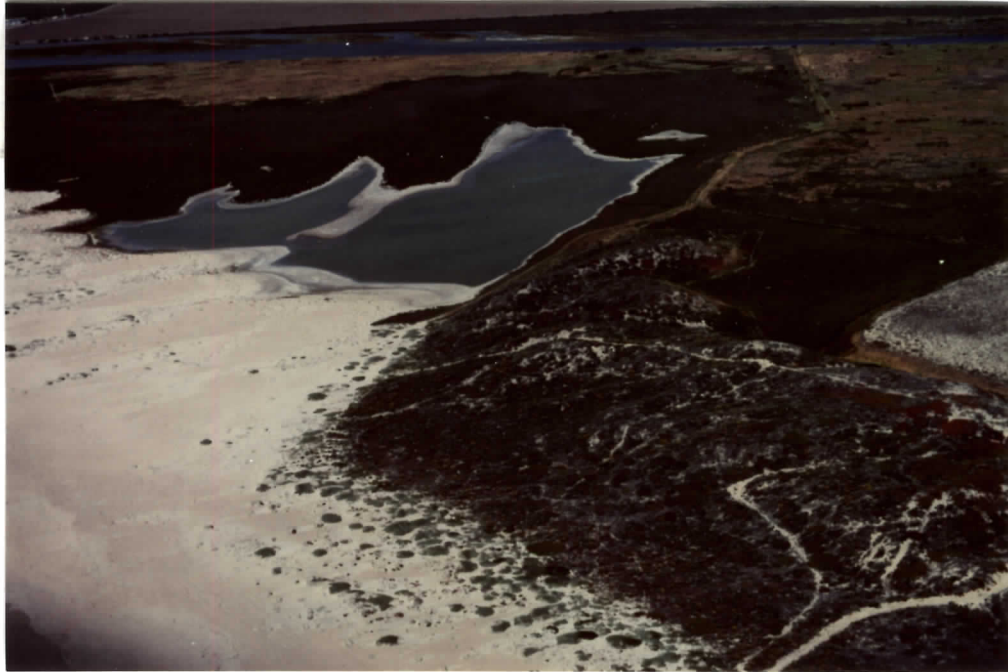
A revenue sharing payment in the amount of \$6657.00 was made to Monterey County. This payment represented 78% of the calculated amount of the 1990 revenue sharing payment as authorized by the Revenue Sharing Act, Public Law 95-469.

F. HABITAT MANAGEMENT

1. General

Habitats found on the refuge are detailed in the introduction. Quality of the habitat found on the dunes and beach is very good. Salt marsh areas undoubtedly have been altered by changes in the water regime in the Salinas River lagoon area. Irrigation draws off a major portion of freshwater inflow and flood control practices (i.e. breaching the front beach and channelization) have changed the hydrology. Upland habitat is overrun by "weedy" species after years of cultivation prior to refuge establishment.

It is not known if the cumulative impacts of successive drought years are significantly impacting the habitat. Most established vegetation appears to be doing well, but little vegetation is getting established in barren and ruderal areas.



Salinas River Wildlife Management Area is comprised of several unique habitat types including high dunes (foreground), low dunes/beach (background - left), pickleweed marsh (background - right), saline pond (center), and developing riparian and upland grasslands (not pictured), (SB).

2. Wetlands

The 45-acre lagoon on the management area is a permanent saline wetland bordered by pickleweed marsh. Water sources for the wetland include a high water table, rainfall, surf overwash of the low dunes and occasional flooding of the Salinas River. The area is extremely attractive to shorebirds, waterfowl and other water-associated birds.

The lagoon area went dry this summer due, in part, to the low rainfall experienced this year. Several species of shorebirds, including snowy plovers, used this newly exposed area as nesting habitat.

6. Other Habitats

For its size, the management area has a very diverse mosaic of habitat types. The beach and low dunes provide feeding and resting areas for many shorebirds such as sanderlings, sandpipers, willets, marbled godwits, and other waterbirds. Snowy plovers nest here and, historically, California least terns, an endangered species, nested on the beach. The high dunes contain many herbaceous and woody shrubs that come alive with colors during the spring. The high dunes provide habitat for many small mammals and resident birds such as California quail. Raptors commonly forage for prey in the dunes and former cropland areas.

9. Fire Management

Former cropland in upland areas has evolved into ruderal habitat dominated by exotic "weeds." This habitat has been identified as a prescribed burn priority, and Refuge staff hope to follow through with a burn in 1991. Ideally, this upland area would be restored to native grasses and shrubs.

10. Pest Control

Refuge personnel and SCA interns again worked on the eradication of ice plant from the native dune system. Herbicide treatments were not applied this year, but should be administered next year. The program has produced good results. Those benefiting include the endangered Smith's Blue butterfly, the wide variety of native plants and the visitors who appreciate the beauty of the plants in bloom.

G. WILDLIFE

1. Wildlife Diversity

Salinas River WMA has a diverse array of wildlife species using the various ecotypes. The two types of dunes support a diversity of plant types that host many species of insects including the endangered Smith's blue butterfly. The black legless lizard is a State species of special concern and a category 2 candidate species that occurs here. Several raptor species use this area, especially during the winter months, and lots of passerine species use Salinas River WMA during migration. This area harbors large concentrations of waterfowl and shorebirds from fall through spring.

2. Endangered and/or Threatened Species

Up to 400 California brown pelicans commonly roost on the sandbar at the mouth of the Salinas River. These birds are present from June through January, arriving from the south after breeding in southern California and Mexico. Brown pelican numbers in adjacent Monterey Bay range from 8,000-10,000.

The Federally endangered Smith's blue butterfly (Euphilotes enoptes) occurs at four specific locations in Monterey County, one of which is the management area. The preferred habitat is high dunes with an abundance of buckwheat plants. On the management area, the host plant is the coastal buckwheat (Eriogonum latifolium) which is quite abundant.

5. Shorebirds, Gulls, Terns, and Allied Species

Thousands of shorebirds use the beach, lagoon, river and marsh habitat during migration and winter. Approximately 20 pairs each of black-necked stilts and American avocets nest near the lagoon. Killdeer and western snowy plovers nest in the low dunes and on islands near the mouth of the Salinas River.

The western snowy plover is currently under consideration for Federal listing as a threatened subspecies, due to a declining trend in the already small population size. The Point Reyes Bird Observatory (PRBO) is currently studying this species throughout California and has color banded birds on the management area.

PRBO volunteers, Mr. and Mrs. John Warriner, reported poor snowy plover nesting success for the SRWMA again this year. The primary reason for the poor success was predation by non-native red fox. Snowy plovers that nested on the dry lagoon substrate seemed to be less susceptible to predation by red fox compared to those which nested on low dune areas. Since the lagoon bottom is not normally exposed and does not usually support nesting birds, red fox may not yet have discovered this potential foraging area. The Warriner's reported seeing red fox regularly throughout 1989.

15. Animal Control

The non-native red fox has recently expanded its range in California to include several coastal areas, including Monterey Bay and San Francisco Bay. The red fox has been found to be a major predator of ground nesting birds including California least terns and light-footed clapper rails in southern California. Therefore, the recent increase in sightings of red fox at SRWMA is of great concern, since this species has been found to be a very efficient predator of the western snowy plover. Gary Page (Point Reyes Bird Observatory, pers. comm) has documented the loss of snowy plover nests to red fox on SRWMA. Since the snowy plover is under consideration for federal listing, efforts should be made to protect it from undue predation. We are currently monitoring dens and fox tracks on and near SRWMA property to assess the number of red fox that may forage on the refuge and to determine foraging patterns. Red fox control is a very controversial issue in California. The problem is being addressed in southern California, where animal rights groups have halted control efforts. We are currently working with the California Department of Fish and Game to develop an acceptable predator control plan.

H. PUBLIC USE

1. General

The refuge is open to the public during daylight hours. Hunting and fishing are allowed during appropriate State seasons. The quality of the beach experience is high for those willing to walk one mile from the parking area to the beach. The walk deters many and results in limiting the number of visitors on the beach. This works to the advantage of wildlife and those visitors who value the experience of seeing wildlife in an isolated setting.

8. Hunting

Hunting effort on Salinas River WMA is concentrated on waterfowl due to the limited abundance of upland species. An estimated 840 hunter hours are spent each year hunting waterfowl on this area. Hunter success averaged approximately 2 birds bagged on days when hunters were surveyed in 1990. Species most common in the bag were mallard, shoveler, ruddy, pintail, and coot.

9. Fishing

Fishing pressure is relatively light but consistent from the beach at Salinas River WMA. Most individuals who fish this area appear to do so with regularity. The most commonly caught species include barred perch, surf perch, and flounder.

PICTURE NOT AVAILABLE

Due to its remote location it is difficult to maintain an adequate presence at SRWMA. Refuge staff emphasize Service presence by contacting visitors when on site. Fishing is a year-round activity with relatively consistent use (SB).

15. Off-Road Vehicling

Use of off-road vehicles continues to be a problem, especially in dune areas where plant restoration efforts have been focused. A potential opportunity to fund remedial action of off-road vehicle impacts came about through the California Department of Fish and Game who had appropriated funds for this purpose. A proposal was submitted requesting funds to replace 1.2 miles of fence and to purchase and install interpretive and regulatory signs. Word has not been received whether funding was approved.

Citations were issued to two individuals for narcotics possession. Both individuals plead guilty and paid fines.

Two waterfowl hunters were cited; one for failure to display a Federal duck stamp, and the other for taking migratory game birds with an unplugged shotgun.

17. Law Enforcement

Law enforcement presence, unfortunately, has not kept pace with unauthorized activities at Salinas River WMA. Several violations occurred during the week of July 4th including off-road vehicle trespass, habitat destruction, and camping. These activities were reported by the adjoining State park staff. Other incidents include illegal gill netting in the river, illegal dumping, and target shooting. An explosive device supposedly used as a military marker for submarine warfare was found at the Salinas River and disposed of. An abandoned life raft with miscellaneous equipment was found stashed in the dunes suggesting some illegal entry or smuggling of contraband.

I. EQUIPMENT AND FACILITIES

2. Rehabilitation

Refuge staff and volunteers cleaned up trash from the parking area and repaired the fence around the parking area and near the entrance road. Boundary signs and interpretive signs in the parking area were replaced or refurbished as were hunting regulatory signs.

7. Other

The guzzler or water storage container for small mammals and birds is located inland of the old established dunes. It was cleaned and repaired, and vegetation was cleared away from it providing access to wildlife.

J. OTHER ITEMS

1. Cooperative Programs

The California Department of Fish and Game and the Service have maintained a cooperative agreement to manage Salinas River Wildlife Management Area for many years. Management concerns of the Service (i.e. snowy plover, Smith's blue butterfly, native dune system rehabilitation, water management and red fox depredation) have not been adequately addressed under the existing cooperative agreement. The Service requested that the Department provide a revised cooperative agreement by January 31, 1990. The goal of the revision was to accurately assess responsibilities and to increase the Department's activities on Salinas River. The Service has taken an active role on the area and wanted

to assess the Department's commitment to the project. The Department did not respond with a revised cooperative agreement, so Refuge staff have asked the Regional office to terminate the cooperative agreement.

3. Credits

This report was prepared by Steve Berendzen and typed by Joan Dawson.

REFUGE FACT SHEET

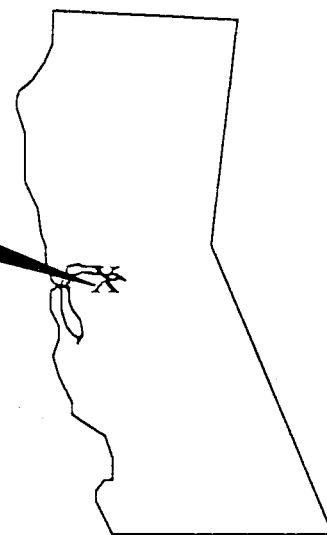
Antioch Dunes National Wildlife Refuge

San Francisco Bay National Wildlife Refuge Complex

P.O. Box 524

Newark, CA 94560

Established: 1980



Refuge Objectives:

- Protect and provide habitat for threatened and endangered species *
- Preserve vanishing and unique habitats and ecosystems

Current Issues of Concern:

- Restoration of dune habitat and stabilization of dune erosion
- Public trespass into closed areas
- Competition from non-native plants on endangered plant species
- Particulate contamination from nearby gypsum plant

Significant Species:

- * Antioch Dunes Evening Primrose
- * Contra Costa Wallflower
- * Lange's Metalmark Butterfly
- * Naked Buckwheat (food plant for endangered butterfly)

Public Use:

- Closed to all public use
- Tours led by Refuge personnel on request

Acreage:

- Authorized: 55
- Current: 55

Habitats

Type	# Acres	% Area
Riverine	3	5.0
Grassland	18	32.0
Cropland	5	9.0
Sand	12	21.0
Brush	16	29.0
Admin.	1	2.0
	<hr/> 55	<hr/> 98.0%

ANTIOCH DUNES NATIONAL WILDLIFE REFUGE

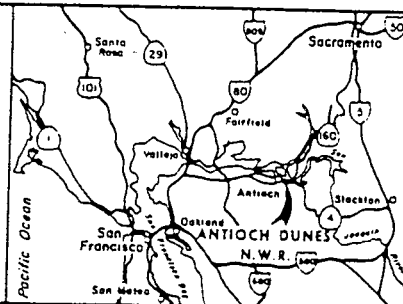
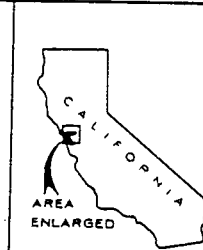
UNITED STATES
DEPARTMENT OF THE INTERIOR

CONTRA COSTA COUNTY, CALIFORNIA

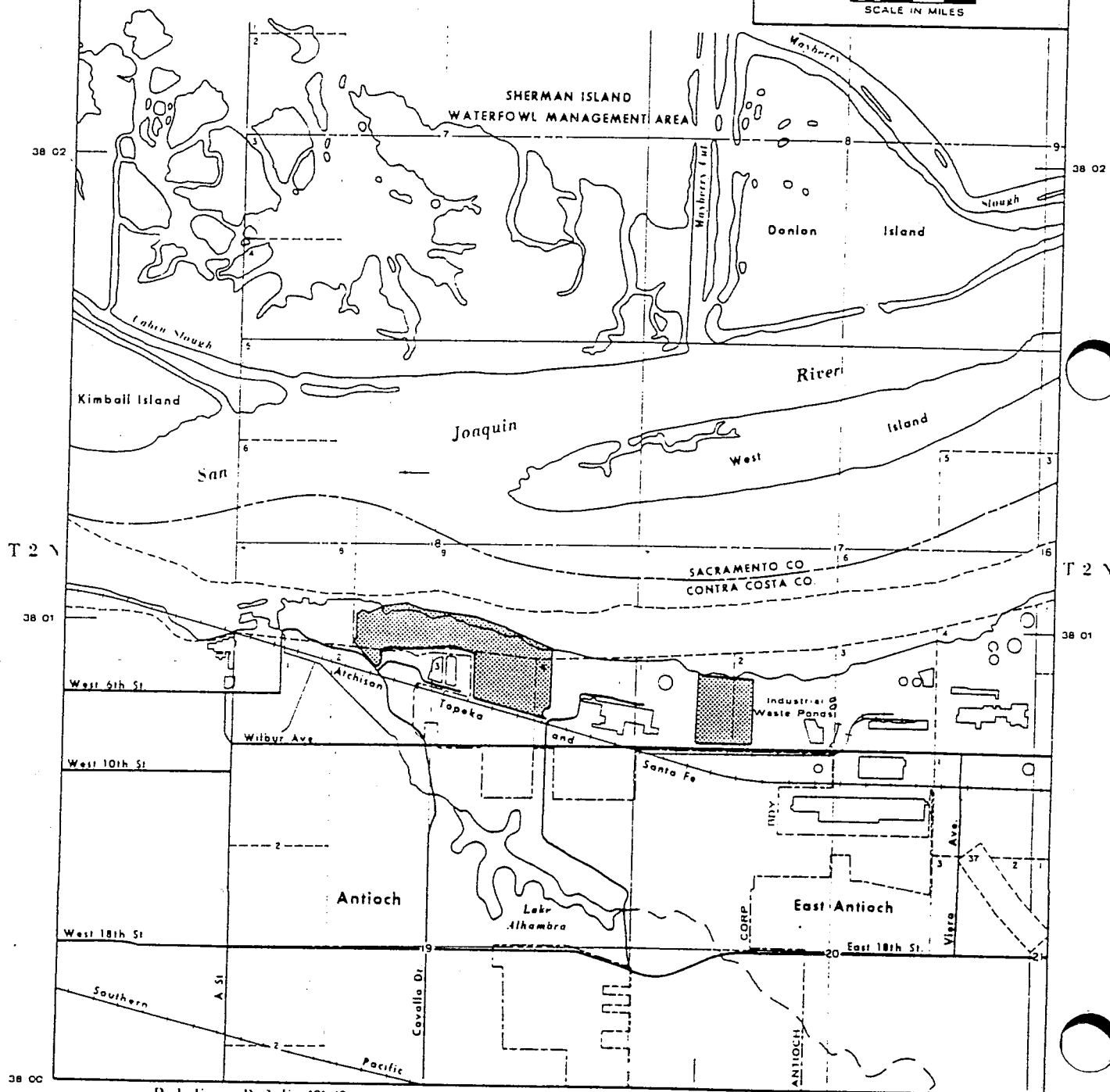
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FISH AND WILDLIFE SERVICE

R 1 E R 2 E 121 48

REFUGE AREA



LOCATION MAP
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SCALE IN MILES

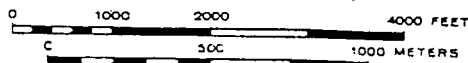


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SURVEYS BY USGS FWS BLM

PORTLAND OREGON
REV 3/94

MARCH 1983

MOUNT DIABLO MERIDIAN



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MEAN
DECLINATION
1980

TR CALIF 965

REFUGE FACT SHEET

Castle Rock National Wildlife Refuge

San Francisco Bay National Wildlife Refuge Complex

P.O. Box 524

Newark, CA 94560

Established: 1980



Refuge Objectives:

- Protect and provide habitat for threatened and endangered species *
- Protect migratory bird resources
- Provide and protect seabird breeding habitat

Significant Species:

- * Aleutian Canada Goose
- Common Murre
- Pelagic Cormorant

Current Issues of Concern:

- Public trespass into closed areas

Public Use:

- Closed to all public use

Habitats

Type	# Acres	% Area
Grassland	5	35.7
Rock	9	64.3
	<hr/> 14	<hr/> 100.00%

Acreage:

- Authorized 14
- Current 14

Table 1



REFUGEE AREA



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REFUGE FACT SHEET

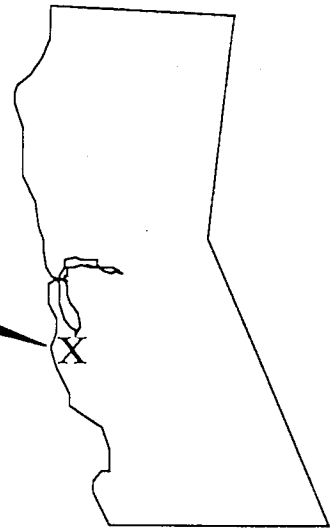
Ellicott Slough National Wildlife Refuge

San Francisco Bay National Wildlife Refuge Complex

P.O. Box 524

Newark, CA 94560

Established: 1975



Refuge Objectives:

- Protect and provide habitat for threatened and endangered species *
- Protect site from human disturbances and maintain quality of habitat
- Provide habitat for migratory birds and other wildlife

Significant Species:

- * Santa Cruz Long-Toed Salamander

Current Issues of Concern:

- Recurring droughts threaten salamander survival
- Development of adjacent areas limits salamander habitat

Public Use:

- Closed to all public use

Habitats		
Type	# Acres	% Area
Upland Oak Woodland and Willow Thicket	128	100
	<hr/> 128	<hr/> 100%

Acreage:

- Authorized: 128
- Current: 128

ELLICOTT SLOUGH NATIONAL WILDLIFE REFUGE

SANTA CLAY COUNTY, CALIFORNIA

UNITED STATES
FISH AND WILDLIFE SERVICE

UNITED STATES
DEPARTMENT OF THE INTERIOR

Part of Lot 41 (G.L.O.)

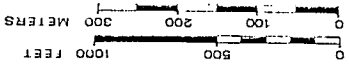
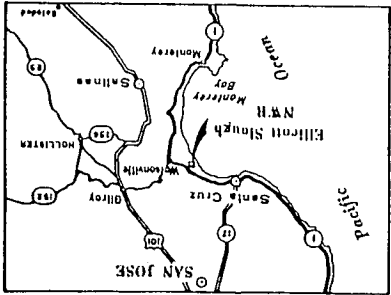
SAN

ANDRES

RANCHO

Note: Small lots are portion lots of G.L.O. Lot 41, San Andres Rancho.

LOCATION MAP
SCALE IN MILES
0 10 20 30 40



MOUNT DIABLO MERIDIAN

PORTLAND OREGON
REV JULY 1980

COMPILED IN REALTY FROM
SURVEYS BY USGS, FWS, BLM

MEAN
DECLINATION
1980
16°15'

IR CALIF 911 101

REFUGE FACT SHEET

Farallons National Wildlife Refuge

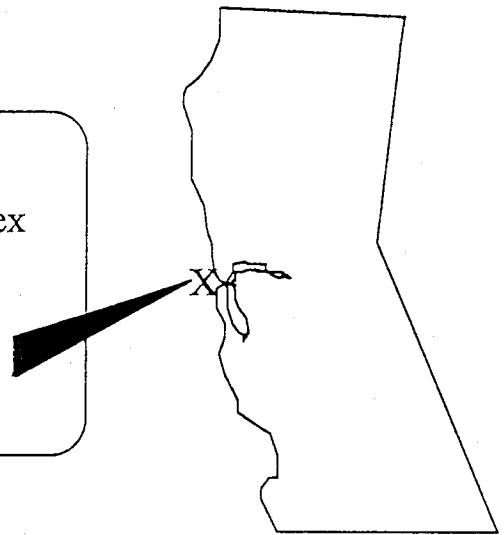
San Francisco Bay National Wildlife Refuge Complex

P.O. Box 524

Newark, CA 94560

Established: 1909

Southeast Farallon: 1969



Refuge Objectives:

- Preserve important seabird nesting area
- Protect migratory birds
- Preserve and protect pinnipeds using the island habitats
- Protect endangered and threatened species *

Current Issues of Concern:

- Gill-netting impact on Common Murres
- Oil spills from sea-going tankers
- Nuclear waste contaminants from possible illegal barrel dumping in 1969
- Human disturbance from boats and aircraft

Significant Species:

- California Sea Lion
- Northern Sea Lion
- Elephant Seal
- * California Brown Pelican
- Brandt's Cormorant
- Common Murre
- Western Gull
- Ashley Storm Petrels
- Cassin's Auklet
- * Peregrine Falcon

Public Use:

- Closed to all public use
- Access by special use permit allowed on a limited basis to media and for scientific studies.

Habitats

Type	# Acres	% Area
Rock	210	99.5
Admin.	1	0.5
	<hr/> 211	<hr/> 100.00%

Acreage:

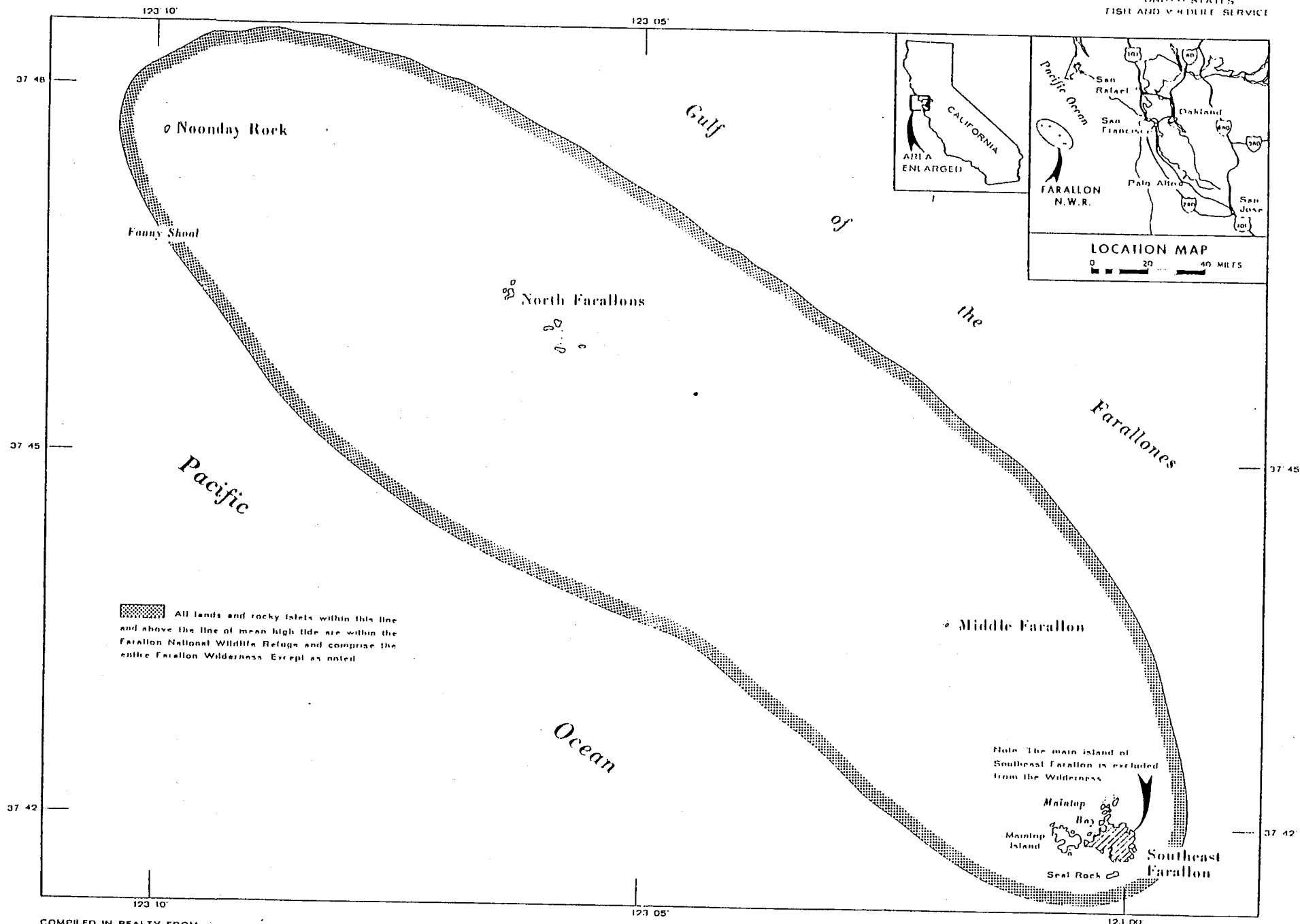
- Authorized: 211
- Current: 211

FARALLON NATIONAL WILDLIFE REFUGE

UNITED STATES
DEPARTMENT OF THE INTERIOR

SAN FRANCISCO COUNTY, CALIFORNIA

UNITED STATES
FISH AND WILDLIFE SERVICE



COMPILED IN REALITY FROM
SURVEYS BY USGS, FWS, BLM

PORT OREGON JULY 1980
REV

0 0.5 2 KILOMETERS
0 10 20 40 MILES

16 45
ION

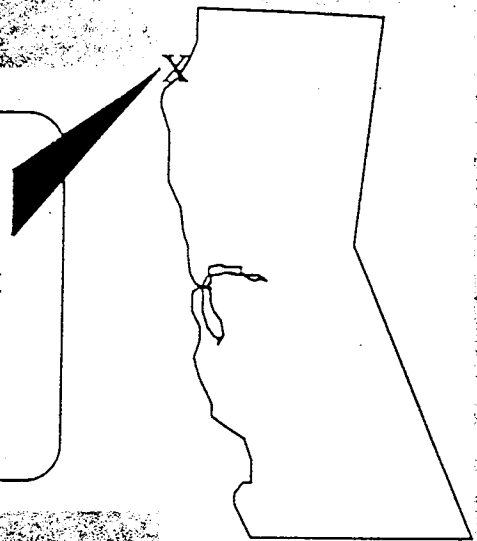
FR CALIF 53 101

REFUGE FACT SHEET

Humboldt Bay National Wildlife Refuge

San Francisco Bay National Wildlife Refuge Complex
P.O. Box 524
Newark, CA 94560

Established: 1971



Refuge Objectives:

- Perpetuate the migratory bird resource
- Preserve and restore the natural diversity of flora and fauna
- Increase the use of Humboldt Bay by the Pacific Black Brant
- Preserve endangered and threatened species *

Current Issues of Concern

- Possible contaminants from agricultural and industrial runoff
- Land acquisition
- Restoration of historic tidal areas
- Potential industrial and agricultural development adjacent to the Refuge

Significant Species:

- Pacific Black Brant
- Pintail
- * California Brown Pelican
- Common Loon
- * Western Snowy Plover
- Hundra Swan
- * Peregrine Falcon

Public Use:

- Environmental education
- Interpretation
- Wildlife observation
- Hunting
- Fishing

Habitats

Type	# Acres	% Area
Estuarine	399	71.1
Grassland	151	26.9
Sand	11	1.9
	<hr/> 561	<hr/> 99.9%

Acreage:

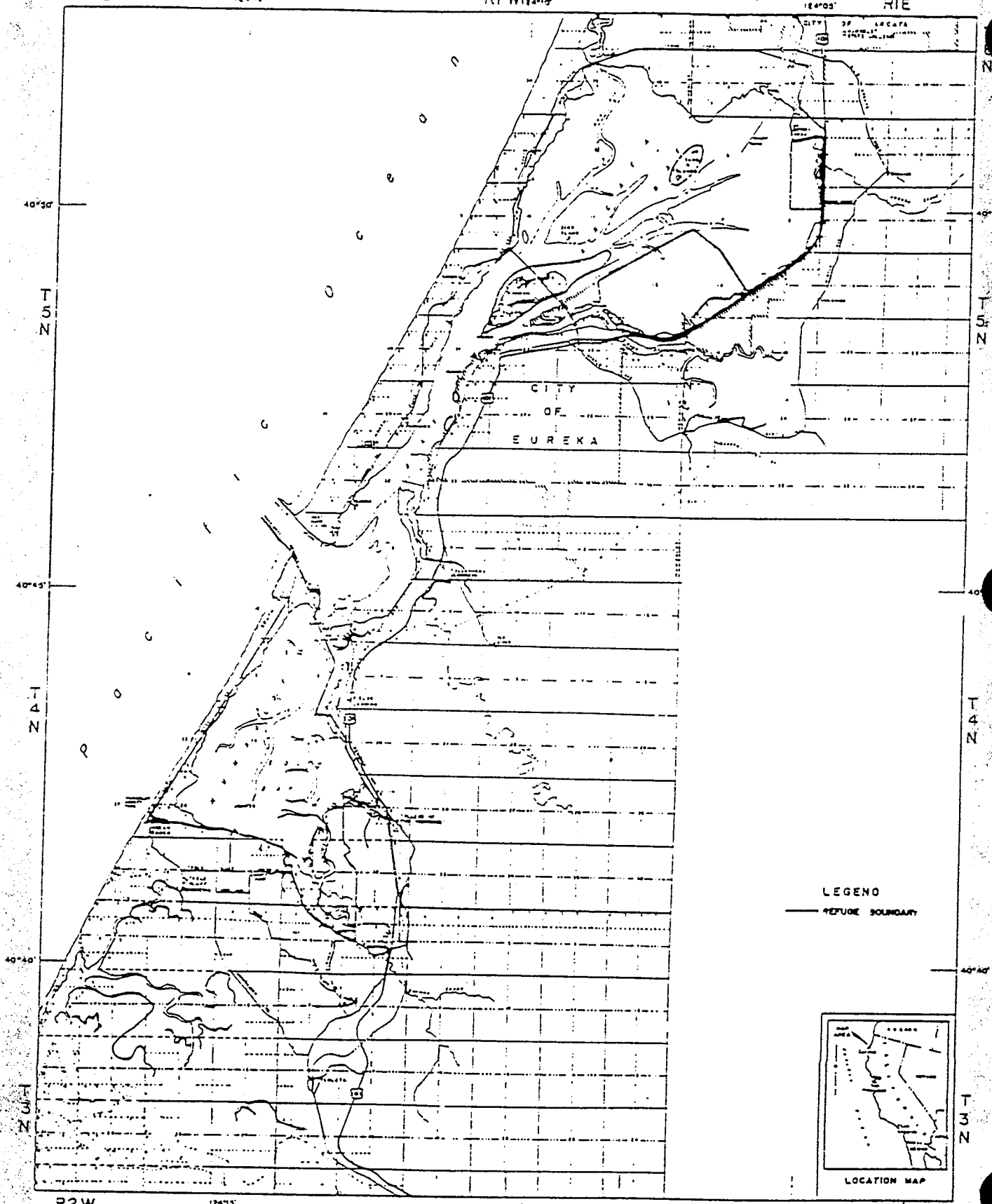
- Authorized: 8506
- Current: 2085

HUMBOLDT BAY NATIONAL WILDLIFE REFUGE

UNITED STATES
DEPARTMENT OF THE INTERIOR
R2W

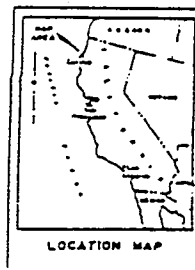
HUMBOLDT COUNTY, CALIFORNIA

FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
RIE



LEGEND

— REFUGE BOUNDARY



LOCATION MAP

R2W
COMPILED IN THE DIVISION OF ENGINEERING
FROM SURVEYS BY C.A.S. AND S.U.P.

RIW

HUMBOLDT MERIDIAN

Scale 0 40 80 120 160 200 CHAINS
0 1 2 3 4 MILES

RIE

MEAN
DECLINATION
1970

PORTLAND, OREGON

JUNE 1971

14 CALIF

REFUGE FACT SHEET

Marin Islands National Wildlife Refuge

San Francisco Bay National Wildlife Refuge Complex
P.O. Box 524
Newark, California 94560

Established: 1992

Preliminary Refuge Objectives:

- protect nesting waterbirds and other wildlife from disturbance
- increase and enhance native habitat for use by nesting and roosting birds
- protect tidal mudflats and unique island ecosystems

Current Issues of Concern:

- disturbance of wildlife by recreational boaters and windsurfers
- Industrial, municipal and agricultural contaminants in San Francisco Bay

Habitats:

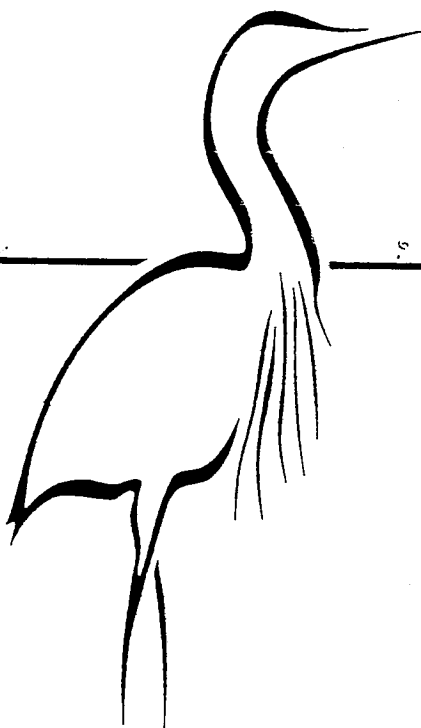
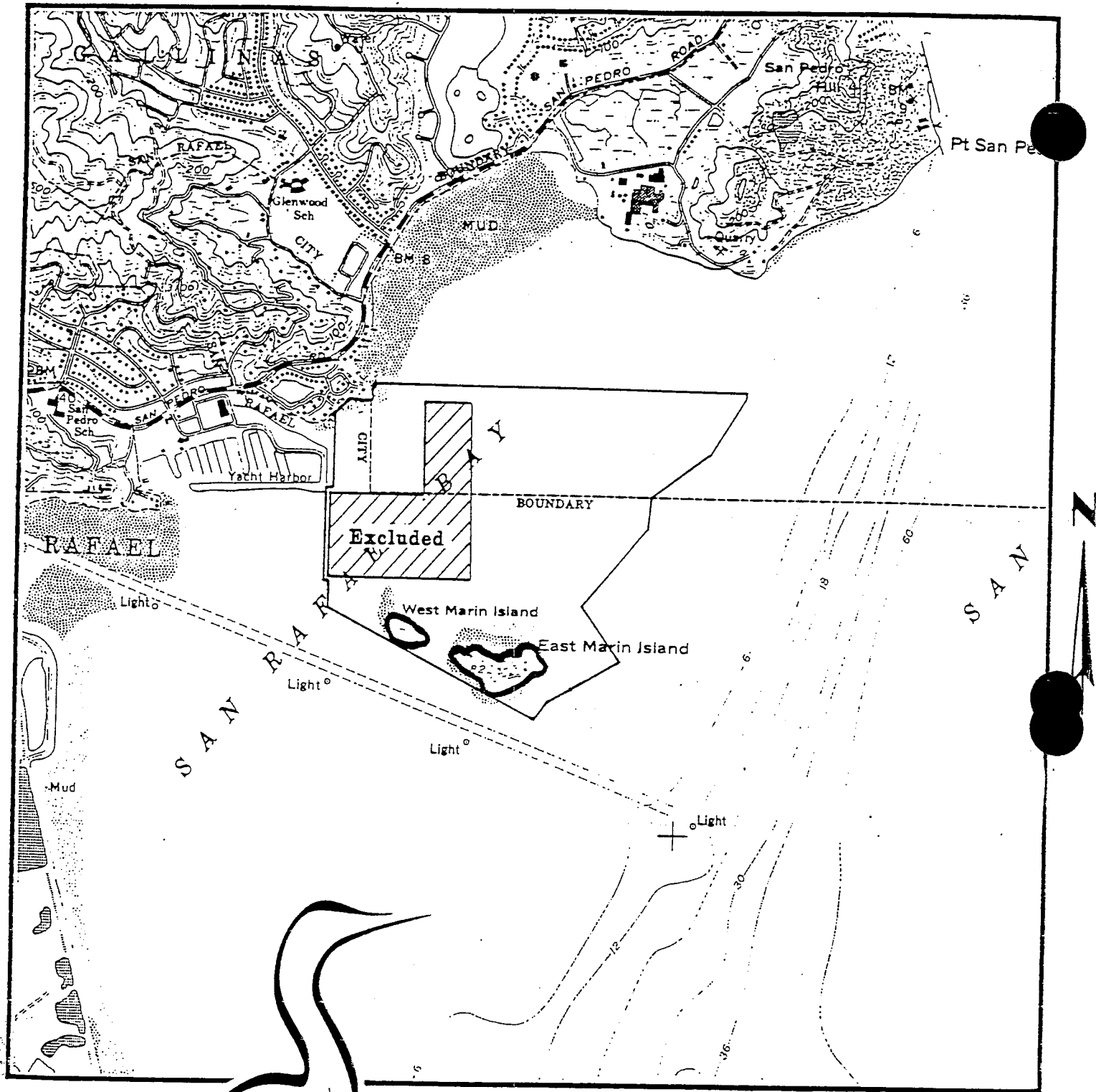
<u>Type</u>	<u># Acres</u>	<u>% Area</u>
tideland	326.21	96
upland	<u>13.08</u>	<u>4</u>
<i>total:</i>	339.28	100%

Significant Species:

- Great egret
- Snowy egret
- Black-crowned night heron
- Black oystercatcher
- Surf scoter

Public Use:

- The refuge is closed to public use.



**Marin Islands National Wildlife Refuge
and State Ecological Reserve**

REFUGE FACT SHEET

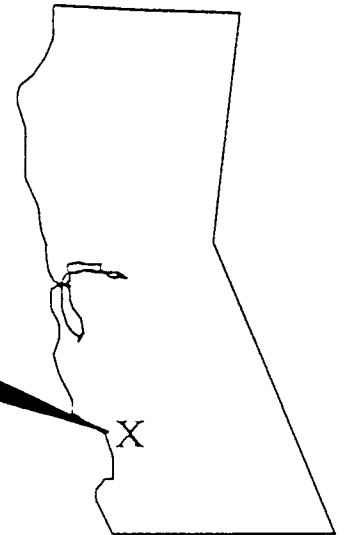
Salinas River Wildlife Management Area

San Francisco Bay National Wildlife Refuge Complex

P.O. Box 524

Newark, CA 94560

Established: 1974



Refuge Objectives:

- Maintain and improve a diversity of habitats
- Protect the dune system and its native flora and fauna
- Provide opportunities for wildlife and wildlands management
- Protect endangered and threatened species *

Significant Species:

- * California Brown Pelican
- * Smith's Blue Butterfly
- * Peregrine Falcon
- * Snowy Plover

Current Issues of Concern:

- Intrusion of off-road vehicles - beach trespass
- Encroachment of exotic vegetation - ice plant
- Joint management with California Department of Fish and Game
- Possible contamination from agricultural runoff

Public Use:

- Hunting
- Fishing
- Wildlife Observation

Habitats

Type	# Acres	% Area
Grasslands	137	26.4
Ocean	130	25.0
Salt marsh	78	15.1
River	74	14.3
Lagoon	45	8.7
Sand dunes	32	6.2
Beach	22	4.2
	<hr/> 518	<hr/> 100.0%

Acreage:

- Authorized: 518
- Current: 518

SALINAS RIVER WILDLIFE MANAGEMENT AREA

UNITED STATES
DEPARTMENT OF THE INTERIOR

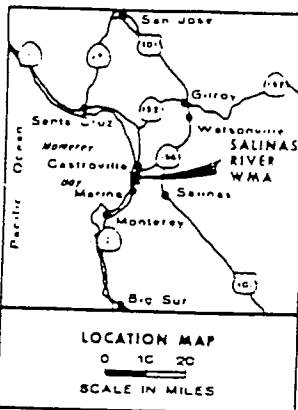
MONTEREY COUNTY, CALIFORNIA

UNITED STATES
FISH AND WILDLIFE SERVICE

R 1 E 121° 48'

R 2 E 121° 47'

121° 47'



Legend
Management Area Boundary

T 13 S

36 45

T 14 S

PACIFIC OCEAN

MONTEREY BAY

36 44

PACIFIC OCEAN

RINCON

DE

LAS

SALINAS

Salinas River

Nepenthe

36 44

T 13 S

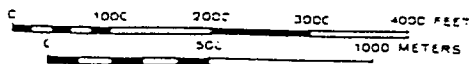
T 14 S

R 1 E 121° 48'

R 2 E 121° 47'

121° 47'

MOUNT DIABLO MERIDIAN



MEAN
DECLINATION
1982

COMPILED IN REALITY FROM
SURVEYS BY USGS FWS BLM

PORTLAND OREGON
REV

MAY 1984

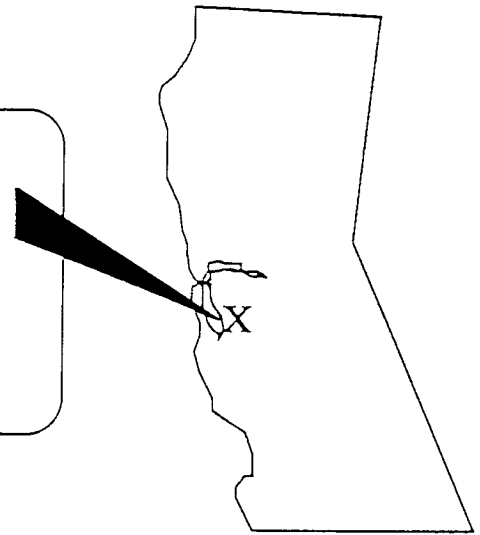
1R CALIF 924 402

REFUGE FACT SHEET

San Francisco Bay National Wildlife Refuge

P.O. Box 524
Newark, CA 94560

Established: 1972



Refuge Objectives:

- Preserve and enhance significant wildlife habitat in South San Francisco Bay
- Provide opportunity for wildlife-oriented recreation and nature study
- Protect migratory waterfowl and endangered and threatened species *

Current Issues of Concern:

- Loss of wetlands - 90% of historic wetlands already lost
- Industrial, municipal, and agricultural contaminants in the Bay
- Land acquisition to complete approved boundary and add seasonal wetlands

Significant Species:

- * California Clapper Rail
- * Salt Marsh Harvest Mouse
- * Peregrine Falcon
- * California Brown Pelican
- * Snowy Plover
- * California Least Tern
- Harbor Seal
- Canvasback
- Pintail

Public Use:

- Environmental education
- Wildlife interpretation
- Wildlife observation
- Non-wildlife oriented recreation
- Hunting
- Fishing

Acreage:

- Authorized: 43000
- Current: 18219

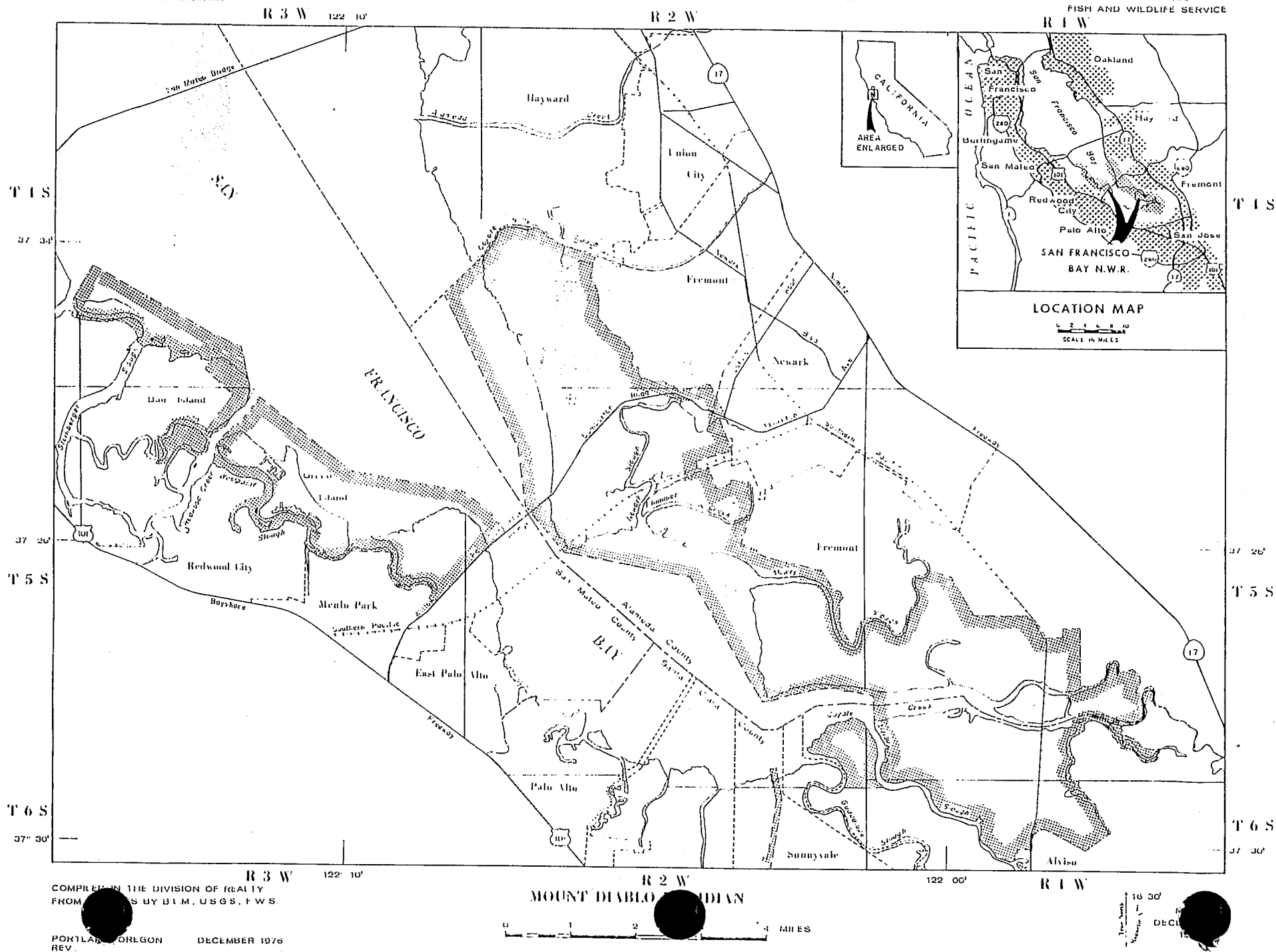
Habitats		
Type	# Acres	% Area
Salt ponds	14029	77.0
Freshwater wetlands	2551	14.0
Uplands	1093	6.0
Salt marsh	182	1.0
Mud flats	182	1.0
Open water	182	1.0
	<hr/> 18219	<hr/> 100.0%

SAN FRANCISCO BAY NATIONAL WILDLIFE REFUGE

UNITED STATES
DEPARTMENT OF THE INTERIOR

ALAMEDA, SAN MATEO, AND SANTA CLARA COUNTIES, CALIFORNIA

UNITED STATES
FISH AND WILDLIFE SERVICE



REFUGE FACT SHEET

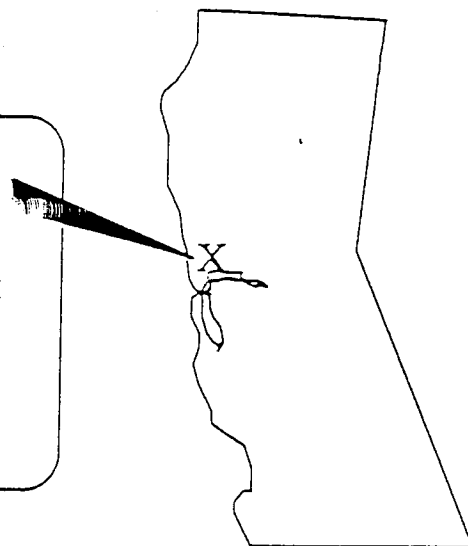
San Pablo Bay National Wildlife Refuge

San Francisco Bay National Wildlife Refuge Complex

P.O. Box 524

Newark, CA 94560

Established: 1970



Refuge Objectives:

- Conserve migratory birds and other wildlife by preserving habitat and open space
- Provide wildlife-oriented outdoor recreation opportunities
- Provide wintering habitat for the Canvasback duck
- Protect endangered and threatened species *

Significant Species:

- Canvasback duck
- * California Clapper Rail
- * Salt Marsh Harvest Mouse
- * Brown Pelican

Current Issues of Concern:

- Possible development along Highway 37 from Vallejo
- Contaminants from agricultural and industrial runoff
- Maintenance of dike and water control structures

Public Use:

- Environmental education
- Wildlife interpretation
- Wildlife & wetlands observation
- Hunting
- Fishing

Habitats

Type	# Acres	% Area
Estuarine	11691	99.94
Grassland	5	0.04
Admin.	1	0.02
	<u>11697</u>	<u>100.00%</u>

Acreage:

- Authorized: 11697
- Current: 11697

